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Shot up — but not Down

"ANYBODY who leaves his money in the aircraft industry needs his head examining." This cheerful sentiment is attributed by the *Stock Exchange Gazette* to "a leading personality in aviation" and prefaces an article in that journal entitled "Shot Down by Sandys."

As an honest attempt at interpreting the industry today we commend the article to any reader having financial interests or aspirations—with a caution against undue depression which its dominant tone of grey might engender. Generally it makes good sense. ("The plain fact of the matter is that the industry passed its cross-roads some way back, and those who realized this before the recent axe fell are still in the fight for survival: those who did not face a bleak prospect.") But also there is an under-estimation of the industry's flexibility and powers of recuperation. ("It is no use expecting those aircraft companies which have been caught out to establish successful production schemes for the manufacture of alternative goods overnight. The way is not easy and aircraft companies are, in any event, far from being temperamentally conditioned to the hurly-burly of competitive mass-production techniques.")

In this last connection the article does point out that companies like Dowty and R. B. Pullin have long been working towards a reduction in their dependence upon the aircraft industry and have succeeded to a very satisfying degree; but the fact seems to have been overlooked that there are few firms in the industry who have *not* chanced their arms outside their primary field—with such items as cars, buildings, industrial electronics, household appliances, industrial hydraulics, computers, armament for the Army and Navy, and marine propulsion.

Since our friends of the *Stock Exchange Gazette* have headed their valuable appraisal in the language of air warfare, we may state our own belief in the same idiom. While perceiving that the aircraft (or, more explicitly, the aeroplane) industry has been well and truly shot-up by Mr. Sandys' salvos of missiles, we fail to discern that it has yet been shot down. There is, admittedly, a great amount of smoke which obscures the continuing affray, the occasional flashes of fire show apparent battle-damage. But the tail—no longer over-heavy—appears to be keeping well up, and stability may well have benefited from the Minister's onslaught. True, certain structural members may be in danger of falling apart; but the integrity of the airframe is not beyond hope.

But enough of this grim militancy. The brighter future is in commerce.

Insecure in the Knowledge . . .

AMONG readership reaction to our Flying Aids feature issue of April 12 we note with particular pleasure the comment of another "leading personality in aviation" who wondered how we had overcome the security regulations in compiling the reviews which that issue contained. The answer is that we had available only such material as had been openly published by the manufacturers concerned. Despite the fact that much of the equipment described is officially "restricted" by joint Anglo-American agreement, its existence and workings have been repeatedly disclosed in America, though stringently withheld in Britain. The American Government has recognized this situation to the extent that tighter security laws are being drafted.

One result of security policies loosely applied in one area and strictly enforced in another is that a civil agency wishing to buy certain equipment learns about the still-secret products of the first area and not about those from the second—even though the latter may be better, cheaper or more closely suited to its requirements. Such a situation obviously affects the business interests of many firms. Meanwhile, the damage caused when the information also reaches a potential enemy appears to be regarded as of secondary importance by the less security-conscious concerns; and their disclosures tend at the same time to invalidate the more tightly enforced regulations.

FROM ALL QUARTERS

May Day Over Moscow

THE customary May Day parade, lasting five hours, took place in Moscow last week. In the lead was a "Bison" four-jet heavy bomber, escorted by Mig-17 jet fighters. Pilot of the bomber was Hero of the Soviet Union Biryukov. "New jet aircraft" of unspecified type (possibly Yak-25s) were led by Hero of the Soviet Union Kharitonov, and bringing up the rear was a formation of "supersonic fighters" (possibly Mig-19s). The fly-past was commanded by Colonel-General of Aviation Rubanov. A Polish radio reporter in Moscow stated that among the aircraft were ten four-jet bombers (presumed Bisons), nine four-turboprop bombers (presumed Bears), 50 twin-jet bombers (presumed Badgers), 50 Yak twin-jet all-weather fighters (presumed Yak-25s), and 65 Mig-19s. The reporter made no mention of Mig-17s, though these are known to have participated.

Immediately after the fly-past Moscow radio broadcast a talk by the Soviet designer Tupolev. "On the eve of May Day," he said, "I was awarded the Lenin Prize for designing the Tu-104 passenger aircraft. I am proud of this high award, and I rejoice all the more because this aircraft has placed our country in the first rank in the world as regards construction of passenger aircraft.

"Our group of designers is now engaged on a new passenger jet aircraft. An improved mark of the Tu-104 is also ready and undergoing tests. It is designed to carry 70 passengers. In the near future new aircraft of this type will appear on the air routes of our country and the people's democracies. This type will soon be followed by the mass production of a four-jet 100-passenger aircraft.

"We are now concentrating on a big aircraft for long-range routes, carrying 170 passengers. Two or three such aircraft will be able to take the place of an express train and carry from Moscow to Khabarovsk the same number of passengers as the train, but in twelve hours only. This aircraft will be equipped with four powerful turboprop engines . . ."

Exports: Successful First Quarter

IN the first quarter of this year British aero exports totalled just under £25m, the March figure of £7,507,253 bringing the total for the first three months of 1957 to £24,257,625. Of this, £13,858,995 was accounted for by aircraft and parts. The U.S.A. headed the list of overseas customers with purchases of aircraft worth £3.4m, followed by Sweden (£2.3m); France (£819,000); Belgium (£700,800); Australia (£668,500); India (£651,200); Netherlands (£550,700); and Canada (£511,200).

Aero engine exports for the first quarter totalled £8,972,530—almost £2m more than for the same period last year and representing the highest quarterly figure ever recorded in this country from the sale of powerplants overseas. Electrical apparatus at £773,669 (some £220,000 up on last year), tyres at £209,719 (£47,000 up) and instruments at £442,712 (£107,000 up) also showed substantial gains.

Beverley Heavy-Drop Record

AS briefly announced last week, a Blackburn Beverley dropped a load of 29,000 lb by parachute on April 29. This is the heaviest single drop on record, though the load—steel plates and other ballast—was only 60 per cent of the Beverley's total payload. Eight G.Q. parachutes, each with a diameter of 66ft and containing nearly 1,000yd of nylon, were employed. The Beverley was flown by Mr. Tim Wood, Blackburn's chief test pilot, and the supply-aimer was a Blackburn flight-test engineer, Mr. Mike Bailey.

The sequence of events was as follows: A 21ft extractor parachute on the rear sill of the Beverley was released and streamed behind the aircraft; the drag of this released the load, which was resting on a platform which in turn rested on a roller-conveyor on the freight floor. The extractor parachute pulled the load clear until a static line attached to the freight floor transferred the pull from the platform to the containers of the main parachutes. The extractor parachute then pulled the containers away and streamed the eight main canopies. These were initially reefed at a "flying diameter" of 4ft in order to ease the opening shock. A mechanical device released the reefs, and the canopies opened to their full diameter. The platform reached the ground falling at about 24ft/sec—the same rate of descent as experienced by a paratrooper. On touchdown the canopies were automatically released.

Another Hawker Siddeley Link?

IT was rumoured in London last week—and later confirmed—that the Hawker-Siddeley Group is negotiating with the shipbuilding firm of John Brown and Co. "to develop nuclear power interests." This follows closely upon the announcement of the Hawker Siddeley offer for the capital of the Brush Group of engineering firms. Hawker Siddeley announced this week that it is seeking stockholders' approval to create six million new Ordinary £1 shares and four million new £1 preference shares will be made.

John Jay Hopkins

WE record with regret the death in Washington on May 3 of Mr. John Jay Hopkins, chairman of the General Dynamics Corporation and of Canadair, Ltd. He was in his 64th year. Mr. Hopkins, who had a background in the law, became a director of the Electric Boat Company (forerunner of General Dynamics) in 1937. It was he who was principally responsible for the acquisition of Canadair, Ltd., in 1946.

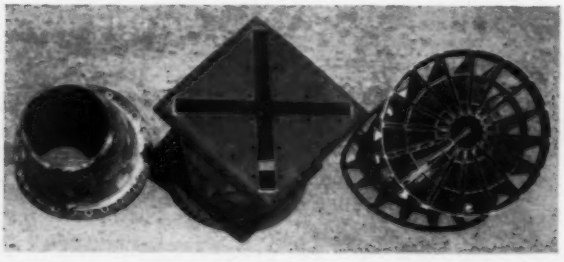
The Turbo-cat

KNOWN by its designers as the Turbo-cat, a new turbine-driven catapult is now being operated by the U.S. Marine Corps. Built by the All American Engineering Company at Georgetown, Delaware, and powered by six turbojets, the device develops 6,000 h.p. A makers' announcement states: "Bi-directional in design, the six jet engines are arranged in a circle with the exhaust gases flowing into the central launching turbines that drive a drum cable system mounted on the same drive shaft. With the jet engines set at a predetermined r.p.m., the flow gate is actuated, diverting the mass flow of powerful exhaust gases into one of the launching turbines, which supplies power to the aircraft through the drum cable system."

Automatic G.C.I.

FURTHER details have now been released concerning the automatic Ground-Controlled Interception equipment which has been developed for the latest U.S.A.F. intercepters, including the F-102A and F-106. Designated AN/GPA-37 Radar Course Directing Group, the overall system was developed by the General Electric Heavy Military Electronic Equipment Department at Syracuse in conjunction with Air Research and Development Command Rome Air Development Center and the Electronics Research Laboratories of Columbia University.

AN/GPA-37 is designed to receive information from long-range



VTO AIRLINER: The first of the Fairey Rotodynes (left) at White Waltham. Its powerplant and rotor are now on the rig at Boscombe Down, illustrated last week. Below are three stages in tip-jet silencer development: a slightly restricted orifice, a cruciform slot giving about 5 db reduction and the 16-pointed slot arrangement (over 10 db). Production Rotodynes will cost between £220,000 and £230,000.

***ACCOUNTANCY:** First photograph of the Southend contender in the DC-3 replacement field, Aviation Traders' Accountant. Estimated selling price of the aircraft is in the region of £140,000. Functional tests, taxying trials and engine runs are now taking place, and the machine should make its maiden flight next month. The power units are two Rolls-Royce Dart 512 turboprops.*

radars, track a potential enemy aircraft and direct intercepters into a position from which they can make their automatic firing runs. Columbia University contributed the AN/GPA-23 Computing-Tracking Group, which is an analogue computer automatically providing the solution of the interception problem for the GPA-37 system. Another element, the AN/GPA-34 Converter Group, processes or "matches" information between components; and the AN/GKA-1 Flight Control Group provides automatic communications between ground installation and intercepter. Although the manœuvring instructions are fed directly into the intercepter's fire-control system, they can also be passed verbally to the pilot.

Two Decca Chains for India

A CONTRACT has been placed with the Decca Navigator Company for two Decca Navigator chains to be set up in India. The chains were ordered by the Indian marine navigation authorities and will be centred on Bombay and Calcutta. In the Bombay area considerable assistance should be provided to shipping during the adverse weather conditions of the monsoon; and navigation in the Ganges delta and Hugli river will be greatly eased in the Calcutta area. Both chains will, of course, equally well serve aircraft. Each will consist of a master and three slave stations, all of which are to be completed in a year.

British Gliding Achievement

A NEW technique in long-distance soaring was employed by Derek Piggott, C.F.I. of the Lasham Gliding Centre, in a flight of 200 miles which completed his "Gold C" requirements on Monday last, May 6. This was to plan the flight in three legs, the last two of which comprised in effect an out-and-return flight between two points. Flying a Weihe, and releasing from an aerotow at 10 a.m., he flew from Lasham to Lewes, Sussex, then to Salisbury and back to Lewes.

This flight, in which Piggott was airborne for the remarkable time (under English conditions) of 9½ hours, was the third attempt by him for "Gold C" distance since April 24. Piggott's cross-countries since April 11, indeed, have logged a total of 630 miles and 27 hours, in only four flights. These consisted of 160 miles on April 11, 110 miles on April 24, 160 miles on May 5 and 200 miles on May 6. The requirements for "Gold C" distance (300 km or 186 miles) permit up to three separate legs, each of at least 80 km.

R.Ae.S Fellowships Announced

AT the annual general meeting of the Royal Aeronautical Society held last Wednesday, May 8, Mr. E. T. Jones, the retiring president, was due to present awards for the best papers published by the Society during the year, and we hope to give details in an early issue. The election of 36 new Fellows was also being officially announced; their names are as follows:—

G. O. Anderson, test and development engineer, piston engines, Bristol Aero-Engines, Ltd.; R. J. Atkinson, senior principal scientific officer, R.A.E., and head of fatigue division of Structures Department; E. H. Bateman, independent scientific investigator to the kinetic heating division of the Structures Department, R.A.E.; R. Beasley, director and general manager, Boulton Paul Aircraft, Ltd.; G. M. Buxton, controller of Guided Weapons Directorate, M.o.S.

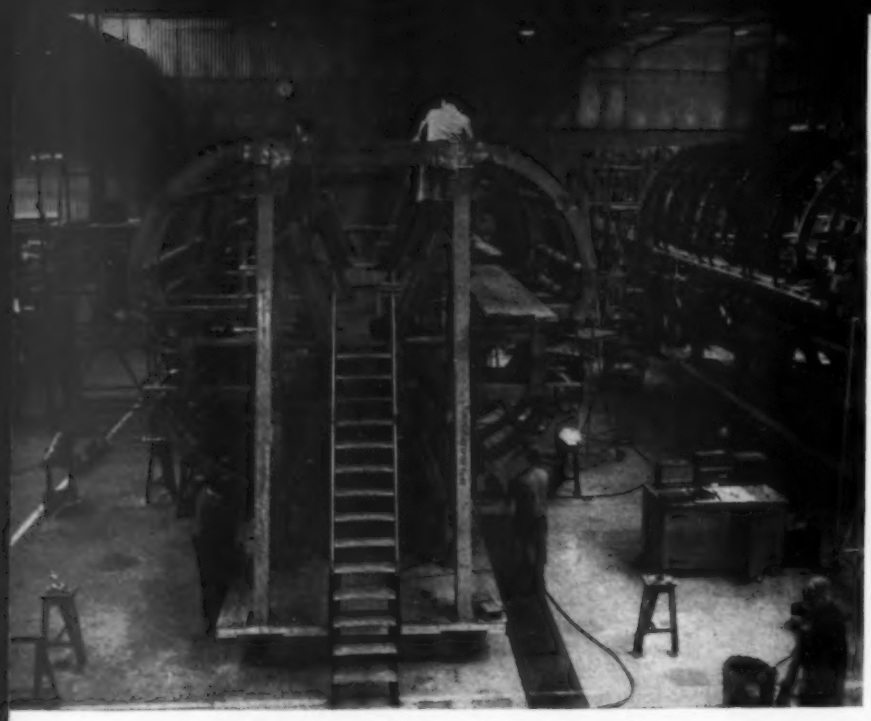
W. Cawood, Principal Director of Scientific Research (Air), M.o.S.; G. D. Dawson, technical adviser, Australian National Airways; R. W. Dunn, chief engineer (aviation instruments), Kelvin and Hughes, Ltd.; L. S. Greenland, director and chief designer, H. M. Hobson, Ltd.; G. Gudmundson, technical director and chief engineer, head of engineering department, Svenska Flygmotor A.B.

G. W. Hall, managing director, Fairey Aviation Co., Ltd.; I. M. Hamer, technical director, Dowty Equipment of Canada, Ltd.; E. H. Heinemann, chief engineer, El Segundo division, Douglas Aircraft Co.; H. G. Herrington, managing director, High Duty Alloys, Ltd.; D. W. Holder, senior principal scientific officer, aerodynamics division, N.P.L., Teddington; A. F. Hutton, Director-General of Engineering, Air Ministry; S. P. Johnston, director, Institute of the Aeronautical Sciences, New York.

J. A. Kay, director and general manager, A. V. Roe and Co., Ltd.; J. F. Lederer, director, Aviation Safety Foundation, New York; J. C. Leslie, administrative vice-president and director, Pan American World Airways; S. W. D. Lockwood, works director and general manager, Sir W. G. Armstrong Whitworth Aircraft, Ltd.; A. J. Murphy, principal, College of Aeronautics; A. S. Niles, professor of aeronautical engineering, Stanford Aeronautics Laboratory, California; J. Norman, chief surveyor, Air Registration Board; P. R. Owen, professor of the mechanics of fluids and director of laboratory, Manchester University.

R. C. Pankhurst, senior principal scientific officer, aerodynamics division, N.P.L., Teddington; J. D. Pearson, deputy chairman and chief executive, Rolls-Royce, Ltd.; C. D. Perkins, professor and chairman, department of aeronautical engineering, Princeton University; C. W. Prower, assistant chief designer (aircraft), Blackburn and General Aircraft, Ltd.; F. G. C. Sandiford, organizer of ramjet development and production, Bristol Aero-Engines, Ltd.; O. A. Saunders, professor and head of mechanical engineering department, City and Guilds College; A. Cdre. T. U. C. Shirley, A.O.C. and Commandant, R.A.F. Technical College, Henlow; Rear-Admiral S. B. Spangler, U.S.N., Naval Air Development Center, Johnsville, Pennsylvania; J. Stack, assistant director, Langley Aeronautical Laboratory, Langley Field, U.S.A.; W. A. Summers, managing director, Hunting Percival Aircraft, Ltd.; R. W. Symmons, head of airworthiness division, Structures Department, R.A.E.

***QUICK GETAWAY:** Concept of an STOL aircraft now being developed by Kaman Aircraft for the U.S. Navy. Controllable flaps on the trailing edges of the rotor blades would give positive control at speeds between 0 and 50 m.p.h. Above that speed the flap control system would automatically phase out and conventional controls take over. Speeds of up to 300 m.p.h. should be possible on turbine power (units unspecified).*



Jigs for Vanguard half-body sections at Weybridge. Since this photograph was taken these, and other, jigs have been filled.

TANGIBLE VANGUARD

G-AOYW Begins to Take Shape

LAST week we were afforded an opportunity of seeing some of the more tangible aspects of the progress being made by Vickers-Armstrongs (Aircraft), Ltd., at Weybridge on the Vanguard turboprop transport (four Rolls-Royce Tyne). This aircraft, which was exclusively described in detail in our issue of July 6 last, is being developed to meet orders placed by British European Airways and Trans-Canada Airlines—twenty aircraft for each operator.

At the outset it is pertinent to comment on the fact that not only has the whole design been able to benefit from an immense amount of experience gained with world-wide operation of the Viscount and Valiant (the latter aircraft has proved very valuable in having already solved many Vanguard problems), but the new airliner is being planned from scratch to meet all British and American requirements and will never have to be re-engineered—as was the Viscount—to meet North American specifications.

It is doubtful if Vickers could find two more competent and valuable operators with whom to develop the Vanguard than those they have already gained as customers. Both have large and experienced project and development staffs, and the V.951 for B.E.A. and V.952 for T.C.A. must, between them, provide a foundation from which any customer's needs can readily be met. The Vanguard is 100 per cent modern and promises to be an uncommonly effective vehicle for any operator whose traffic is heavy enough for such capable equipment.

A picture in our issue of March 29 showed the full-scale mock-up which, although built of wood and used for furnishing development above the floor, is also serving as a true engineering mock-up. It is being equipped with full accessory services so that, for example, it will be possible to determine the run of a pipe on the mock-up and thereafter to use the pipe as a master from which tooling can be made.

Full specifications for the aircraft have, of course, long been published, but the sheer size of the mock-up makes no mean impact on anyone accustomed to existing four-engined transports. One of the basic philosophies underlying the layout is that it is very nearly possible to load the design maximum payload as freight under the floor, ignoring the passenger accommodation entirely. One could easily spend a whole day exploring the under-floor areas of the mock-up, and there would still be plenty to be learned.

At the front end is a dielectric nose-cap, the shape of which has recently been slightly pulled out to permit the accommodation of a 30in scanner. Next comes a flat pressure-bulkhead, and aft of it is a bay in which flying-control circuits, ram-air intake ducts and other services can be reached through a ventral hatch by a man standing on the ground. With a ladder one can climb up to the back of the pilots' instrument panels (complete panels are now being installed).

The forward freight hold is enormous. Even when making full allowance for additional under-floor equipment and cleared areas for other purposes, Vickers estimate that some 1,360 cu ft of freight could readily be accommodated. The pressure-bearing freight doors, 5ft 6in wide by 4ft 3in projected height, are divided into upper and lower portions which are mechanically linked to counterbalance each other.

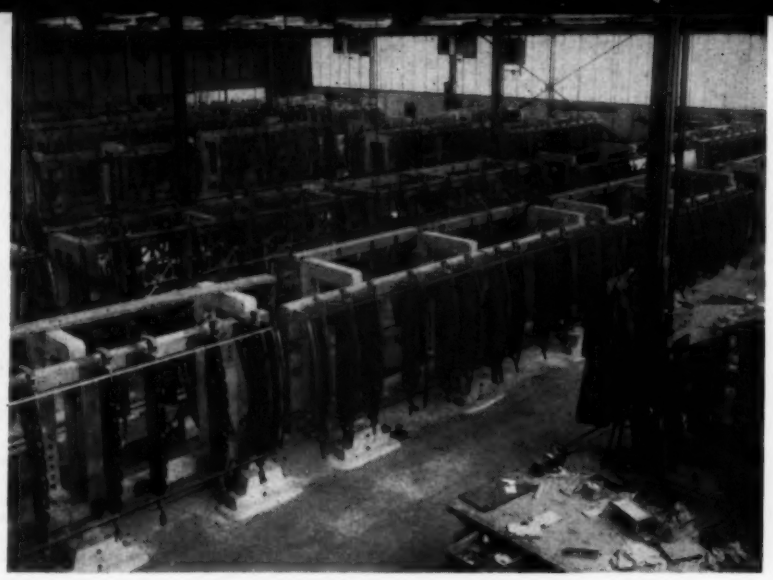
At the front end of the bay provision is made for a mass of radio and electronic gear, on either S.B.A.C. or A.T.R. racks, and rails are provided under the roof (i.e., beneath the main floor) along which the air/air heat exchangers for the cabin-conditioning system travel when they are installed. Engine controls pass down each side of the aircraft but most of the "plumbing" is ranged on the port side. The only high-pressure hydraulics are those for the nose-wheel, and they are contained in a separate mist-proof conduit—probably to be provided with zip-fastened inspection sleeves—some 10ft away from the main electric cables. At the forward end of the rear freight compartment is a self-contained hydraulics bay (reached from outside the aircraft) the pressure in which is maintained at a slightly lower value than that inside the rest of the fuselage. All the belly hatches provided for maintenance purposes will admit one or more men standing on the ground, who can work comfortably in any weather conditions without any trestling.

In the main works at Weybridge one can today see the final batches of Valiants going through—beautiful shapes gleaming in their pristine white paint—supplemented by an assortment of Viscounts (bulk Viscount production is in *ad hoc* shops across the airfield and at Hurn). Gradually, however, the floor is being cleared for the Vanguard, and already numerous jigs for major airframe portions are in position, some being occupied.

Most impressive—perhaps by reason of their height—are those for the fuselage sections. Starting with a concrete base, a massive foundation is put in and used to support a vast assemblage of welded and bolted members formed from channels welded to form box beams. The end-location frames are heavy castings and key stringers are located off nine longitudinal tubular members in each half-jig. Each front and rear fuselage section is made in port and starboard halves, although upper and lower bubbles are made together. Skin is applied in large panels, as in the Valiant, giving an outstandingly good finish. Windows are similar in shape and size to those of the Viscount; one illustration shows the heavy jig locations for the cut-outs. The skins are stiffened alongside each cut-out by fishplate doublers riveted through to the frames, the latter being of flattened figure-3 section. During assembly the skin panels are held firmly in place by hooks, hinged to the frames, which grip the Z-stringers on the skins.

Altogether the fuselage is made in five sections. The floor joins the chines between the two "bubbles" and is arranged in removable sections incorporating integral seat rails. One of the latter is provided on each side of the centre-line of the aircraft, and is used in conjunction with seat fixtures on the walls; seat attachments are continuous throughout the pressurized area to suit a variety of internal configurations. There is no continuous keel or stringer structure, and the five fuselage sections are each built as virtually finished "chunks" which are only offered up in final assembly. In the final erection jig the nose, centre section (including the centre wing) and tail-end are inserted first. The three portions are then joined by completing the floor in the remaining sections, i.e., in the forward and rear fuselage, the whole structure being completed by bringing in the latter portions as half-bodies joined on the upper and lower centre-lines.

Although cabin dP is only 6½ lb/sq in (as in the Viscount) the ruling fuselage skin-gauge is 19, so that stress-levels are somewhat lower. The thicker skin may also offer a better outside tolerance, important in a 400-m.p.h.-plus aeroplane. Doors are of the parallel-link type used on the Viscount 800 family, with similar



A large floor-area has been filled with concrete jigging for fuselage skin panels. Window locators resemble oval wheels.

over-dead-centre locking claws. As in the Valiant, all exterior rivets are flush and milled smooth.

Wing construction marks a complete departure from most traditional practice. The basis is a strong torsion box, used as an integral tank from the roots almost to the tips, with machined-plank skins above and below joined by three shear webs with lightening holes. The machined planks are parallel-edged and fade out naturally as the wing tapers; the integral stiffeners do likewise. A manufacturer's break-joint is provided just outboard of the outer nacelles. The wing torsion-boxes are assembled in jigs which are, if anything, even more massive than those of the fuselage sections. The jig end-location members, each weighing perhaps half-a-ton, slide on rollers to allow the wings to come out. The machined (unclad) planks will be protected by anti-corrosive skins, overlaid by epoxy-resin and paint.

Most of the wing box was evaluated by a special test structure, half the depth of the true torsion box and of constant section, but otherwise identical to the aircraft wing in stiffness, strength and general structural behaviour. This rig was also used to prove the sealing of the integral tankage. The Vanguard has a four-tank system, the inboard bays each holding 1,850 Imp. gal and the outers 700. A tank-test rig was obtained by building a representative wing torsion-box and mounting it on top of the existing Valiant rig. Tank access is provided in the Vanguard by large removable panels above the inner wing and through doors on the front and rear shear webs outboard. Fuelling is done through a single point (which can be fitted with a paired trouser to suit Viscount-type sockets) in the port inner wing. The maximum flow-rate (50 lb/sq in) is no less than 600 gal/min—valuable for quick turn-rounds—and defuelling at 120 gal/min is possible at −11 lb/sq in.

Flying controls are all manual; but the tabs are very large. The rudder tab, for example, has almost as much chord at the root as a Viscount aileron, and it runs the full length of the surface. The ailerons are split into sections, to prevent hinge binding; if the beak on the leading edge is included, their root chord is well over five feet, and total wing chord at their inboard ends is exactly 12 feet. The flaps are of constant-chord Fowler type, with a maximum deflection of 40 deg, nearly all of the angular movement coming in the last 15 per cent of travel. A single Vickers-designed hydraulic actuator, with rotary torque-tube output, is positioned in the inboard starboard wing and drives all flap sections through spanwise tubing and chordwise cables.

All four powerplants are fully interchangeable ahead of the firewalls, and a representative Tyne engine has been built into the mock-up. Propellers, by de Havilland, will have phase-synchronization, and engineering of the complete powerplant and its control system is largely complete. The Stage II Tyne, which will probably go into most Vanguards from scratch, is currently rated at about 4,830 e.h.p.

Vickers are hoping to fly the first V.951 off the B.E.A. line in the autumn of 1958—which, in practice, is likely to mean that if all goes well the aircraft will be at next year's S.B.A.C. show. Working back from that, it takes about nine months from a carcase to a finished machine, so the first fuselage should be complete by November. Actual construction in jigs began in the middle of last month. T.C.A. machines are roughly six months behind those for B.E.A., delivery dates being spring of 1960 to the British operator and the autumn of that year to Canada.

The entire programme is a private venture, financed by Vickers money. The first aircraft, G-AOYW, will be in all respects a production aeroplane and it will eventually be delivered to B.E.A. This policy makes the mock-up exceptionally valuable.

MORE ABOUT THE SC.1

SOME hitherto unpublished facts about the Short SC.1 were disclosed by Mr. F. P. Youens, Short Bros. and Harland advance projects engineer, in a "section" lecture to the Royal Aeronautical Society on April 30.

Discussing this aircraft as an illustration of his subject—*Research Aircraft: their Purpose and Problems*—he said that its undercarriage had wheels which were capable of castoring through 360 deg. This was a research feature and would not necessarily be required on an operational VTOL aircraft, but it did raise a rather unusual problem. As must be the case on many tailless designs, there was not a great deal of spare elevator-power to lift the nosewheel during take-off and, as the SC.1 was to fly as a conventional aeroplane as well as a VTOL one, it was necessary that the main undercarriage should be located fairly near to the c.g. During the take-off run the castors would naturally trail, so that the wheel centre-line was behind the oleo centre-line; but in a vertical landing there might be a small rearward velocity, so that the castors would swing forward and reduce the offset from the c.g. to such a small value that there would be a real danger of the aeroplane tipping over on to its tail. Various solutions were considered, and the one finally adopted owed much to the variable-position undercarriage of the earlier SB.5. In effect, the main-wheels could be moved to a rearward position for VTOL by adjustment of the length of the drag-strut, but in this case the operation was capable of being performed while the aeroplane was airborne, the drag strut being simply a two-position jack.

Earlier in his lecture Mr. Youens had discussed the relative value of (a) ground predictions and (b) a research aircraft. The latter was a very expensive piece of apparatus, from which it took a long time to get results; and it was often difficult or impossible to measure qualities as conveniently as could be done in a wind tunnel or test rig.

On the other hand, conditions under which ground predictions were inadequate could be summarized as (1) uncertainty of tunnel results and theoretical predictions on novel configurations; (2) the possibility that the theoretical framework would not adequately represent the behaviour of an aeroplane of novel configuration or in a novel flight regime; (3) the possibility that new problems would arise in novel circumstances—problems which were unforeseen simply because one did not look for them. To these three might reasonably be added a fourth, in that we did not really know how serious the problems were from the pilot's point of view until a manned aircraft had flown.

Whether or not the information to be obtained was sufficiently important to justify the expenditure, and whether or not it was likely to remain so for the two or three years it took to obtain results, were much more difficult questions to answer. It all depended on an assessment of future design trends and a careful consideration of the ultimate gains to be expected from any new idea.

In a further reference to the SC.1, Mr. Youens said that the fundamental problem to be solved was that of stability and control in hovering and transition flight, and the development of techniques of making transitions from hovering to wing-borne flight and vice versa. These features "had involved Shorts in much fascinating work."

It was difficult to assess what shape future aircraft were likely to take; but, of the well-tried configurations, a tailless delta seemed likely most nearly to represent the sort of low-speed aerodynamics that would have to be dealt with. In addition to the aerodynamic features of the SC.1 it was necessary to have a light structure, since, being a research aircraft, the machine had to do everything a normal aircraft could do, plus VTOL, and also carry a substantial amount of test equipment.

HERE AND THERE

Von Kármán on Lanchester

YESTERDAY, May 9, the first Lanchester Memorial Lecture was due to be delivered before the Royal Aeronautical Society by Dr. Theodor von Kármán, who is an Honorary Fellow of the Society and chairman of the NATO Advisory Group for Aeronautical Research and Development. The lecture was announced by the Society as "an appreciation by one of the greatest living authorities on aerodynamics of a great English aerodynamicist."

German Fighter Pilot's Death

HEINZ BAER, who held the rank of lieutenant-colonel in the Luftwaffe and who was credited with 200 Allied aircraft shot down during the last war, was killed when a Zaunkoenig ultra-light which he was flying from Waggum airfield, near Brunswick, crashed from 100ft on April 28.

Short-Field Grumman

IT is unofficially reported in the U.S.A. that the "high-performance observation aircraft" under development by Grumman for both the U.S. Navy and Army will fly in 1959. It is to be a 350 m.p.h. short-field aircraft with a very good power/weight ratio. Powerplants will be either Lycoming T53s or G.E. T58s, driving large propellers. Designation will be VOX for the Navy and AO for the Army.

Sycamore Rescues Sycamore

AFTER being forced to make an autorotational landing in the Australian National Airways' Sycamore helicopter *Yarrana* in wild country near Mount Sorrel, some 19 miles from Queenstown, Capt. Max Holyman and his passenger were rescued after 41 hours by another Sycamore from the R.A.N. Air Station at Nowra. Water in the auxiliary fuel tank was the cause of their misadventure, which occurred while the aircraft was on charter to an Australian mining company. A rescue party which reached them on foot was also picked up by the R.A.N. Sycamore.

EN FAMILLE: More than ever a family affair is the firm of F. G. Miles, Ltd. Seen with the new Anglo-French H.D.M.105 ("Flight," April 19) and with Hurel-Dubois sales manager Emil Escande (left) are Mrs. "Blossom" Miles; her husband "F.G."; daughter Mary; Corinne Miles and husband George; and Susan Miles and husband Jeremy (F.G.'s son).

Met. for the Million

THE Air Ministry's travelling Meteorological Office Exhibition opens in Coventry tomorrow, May 11, and will stay there for three weeks.

Holland Wants Civil Trainers

THE Dutch Government, which needs about 30 new aircraft for basic training of airline pilots, is evaluating a Beechcraft Mentor, a Saab 91C and a Piaggio.

Dutch Air Force Base

THE Royal Dutch Air Force is to put into operation this year a new base known as De Rips, near Deurne, about 30 miles from the West German border. Jet fighters are likely to be stationed there, and also at Deelen, near Arnhem.

S.B.A.C. Educational Grants

THE Royal Aeronautical Society reminds intending applicants for British Aircraft Constructors' educational grants (which the R.Ae.S. administers) that the closing date for this year's applications is June 30. The grants are designed for the assistance of young men who are unable, for financial reasons, to obtain training in aeronautical engineering. Holders of the grants are expected to qualify for a technical grade in the R.Ae.S. Applicants (who should address their inquiries to the Secretary, Royal Aeronautical Society, 4 Hamilton Place, London, W.1) should be between the ages of 16 and 18 on September 1 this year.

New French Air Attaché

HAVING completed his tour of duty as French Air Attaché in London, Général de Brigade Aérienne A. Puget has left this country and is succeeded by Col. J. de Loustal.

Runnymede Memorial Service

THIS year's Service of Commemoration at the Runnymede Memorial, Cooper's Hill, Egham, Surrey, will be held next Tuesday afternoon, May 14, at 3.15 p.m. Previously the service has been a morning one; on this occasion—the fourth—it is being held in the afternoon to facilitate attendance by relatives and visitors from overseas.

WS-125A Cut Back

FOR the second time in six years the U.S. Air Force has decelerated its Weapon System 125A for a nuclear-powered bomber. Companies contracting are Pratt and Whitney and General Electric (propulsion) and Lockheed and Convair (airframe). Donald Quaries, Secretary for the Air Force, claimed last week that the existing programmes would put into the air a nuclear-powered research aircraft; what was wanted was a supersonic bomber. The current year's spending has therefore been cut to about one-quarter of the $600m originally voted.

The Growth of Club Flying

A LETTER published in our Correspondence columns on April 26 questioned a statement by Mr. Airey Neave, Joint Parliamentary Secretary to the Ministry of Transport and Civil Aviation, who was reported (*Flight*, March 29) to have said in a Commons debate that "140 operational flying clubs" were now in existence. The writer of the letter challenged this figure, stating that it must have included the Flying Groups also. Reference to *Hansard* shows that this was in fact the case: there Mr. Airey Neave is recorded as saying: "There are today 148 operational flying clubs and groups in the United Kingdom, as compared with about 50 in 1948. That shows how this keenness is growing."

TO COMMEMORATE
THE FIRST CROSSING FROM EAST TO WEST
AND THE FIRST DOUBLE CROSSING OF
THE ATLANTIC BY AIR
ACCOMPLISHED BY THE BRITISH AIRSHIP
R 34

COMMEMORATIVE of the first east-west and first double crossing of the Atlantic (by the airship R.34 in July 1919), this monument, erected by the Air League, was unveiled by the Duke of Hamilton and Brandon at East Fortune (point of departure) on May 4. Five members of the original crew were present at the ceremony. A replica of the monument is to be erected at Mineola, near New York.

Thoughts on British Missiles

Notes on Policy in the Guided Weapon Field

By THE TECHNICAL EDITOR

FOR several years past officially authorized information on our guided-weapon programmes has been conspicuously absent. The bulk of the material that was available a few months ago comprised unofficial assertions by British writers or "leaks" by the Press of other countries.

This journal's "Guided Missiles" issue of December 7 last included an appraisal of the world's aspirations and achievements in this great field; but the overall British contribution to the picture could be discerned but dimly. This was to some extent because at that time we did not, as a nation, know fully what we were about. Since February much has happened that—for good or ill, and probably for equal proportions of both—will shape the pattern of our defence efforts for the next decade.

It is now possible to collect a number of new facts which, when wrapped up with appropriate explanation and comment, should throw new light on what we have been trying to do in the guided-weapon field and what we have succeeded in accomplishing. Altogether the picture is far from discouraging. In the December 7 issue mentioned above was published comment on the government statement, made early in 1956, that British missile programmes were then "approximately three years behind those of America in the overall field." It was given as the writer's opinion that this was "a rather sweeping contention that could be challenged." This opinion is strengthened by the fact that one may now refer to the three most important British programmes for operational missiles.

Altogether, by restricting our advance to a relatively narrow front—in comparison with the U.S.A., that is—our policy of missing out whole generations of weapons, and advancing in massive leaps seems to be largely paying off. This leap-frog doctrine has governed everything that we have tried to do in the defence field since the end of World War 2. One calculated risk after another has allowed us to jump over the B-47/Sabre/Mig-15 generation of aircraft and to by-pass the Nike/Terrier/Falcon generation of guided weapons.

There is, however, one very important long-term factor which any nation indulging in "big leaps" would do well to watch closely. There comes a time in every field of complex technological development when it is no longer possible to "gate-crash" from outer darkness to a world-beating concept allied with a reasonable time scale. Any nation which wishes to make a DC-8-rival capable of beating the time-scale of Douglas must first have made a Comet or similar first-generation aeroplane. By the same token, any nation which decides to make an intercontinental ballistic missile capable of rivalling in timing those of the U.S.S.R. and U.S.A. must first have made ballistic missiles of simpler character. This belief has nothing to do with information embargoes under the McCarron Act; it is a straightforward assertion that, although one can sometimes miss out *one* generation of weapons in an effort to save money, one can hardly ever afford to miss out two. It is for this reason that one welcomes our decision to buy ballistic missiles from the U.S.A.; but more of that anon.

Strategic weapons of the IRBM/ICBM type are discussed towards the end of this account, in the section headed "Surface-to-surface." The "air-to-surface" section is preceded by a section dealing with surface-to-air developments (i.e., ground-launched anti-aircraft weapons), and the first section is a dissertation on air-to-air missiles. The latter are generally short-range weapons of modest size. Although frequently of very advanced conception, they pose rather fewer design problems than do ground-fired weapons, and, as far as the R.A.F. is concerned, will be the first type to go into service.

Air-to-air. Earliest of all British guided weapons to be released in public—in both senses of the phrase—was the air-to-air missile known as Fireflash, by the Weapon Division of The Fairey Aviation Co., Ltd., Heston, Middlesex. As is now well known, it is a beam-rider. Boost to high supersonic speed is effected by upper and lower solid-propellant motors, which jettison at burn-out leaving a clean "dart" which can coast for several miles before its power of manœuvre drops below the acceptable minimum.

As it has no internal sustainer motor—a fact which renders it almost unique among currently known missiles—its rearward-facing aerials can "see" the fighter's guiding beam perfectly, without interference from a rocket-motor flame. Moreover, the fact that the whole missile body is devoted to warhead, guidance and control, means that the warhead size may be larger than the dimensions of the body might suggest. Nevertheless, it is at present regarded by the R.A.F. solely as a training and indoctrination weapon. It is in full production for allocation to a unit or units equipped with the Supermarine Swift Mk 7 missile-carrier, of which a number are currently flying in Anglesey and elsewhere. Fireflash can also be carried by the Hawker Hunter—an effective combination which is available for export—and (official pronouncements notwithstanding) may yet be placed in accelerated production for the R.A.F. should the need arise.

Roaring out from its launching aircraft goes Firestreak, by de Havilland Propellers. Fins and wings are indexed diagonally.

Until last autumn Vickers-Armstrongs (Aircraft), Ltd., at Weybridge, Surrey, were prime contractors to the Ministry of Supply for a very advanced air-to-air weapon system intended to be applied to future twin-engined all-weather and day fighters of the R.A.F. and Royal Navy. Little security leakage had occurred on this weapon when its development was cancelled. Cessation of development was due solely to the fact that one of the chief applications—which, by inference, one can deduce to have been the supersonic development of the Javelin—fell before the economy axe.

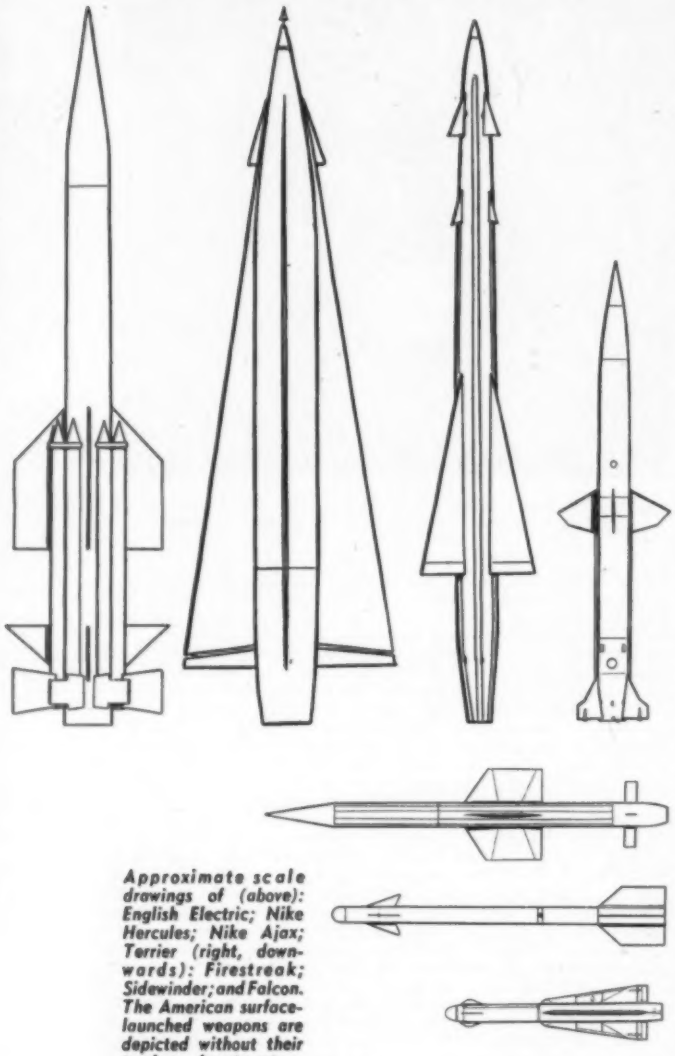
Elimination of the big Vickers weapon left only one publicly announced contractor in the field of British air-to-air missiles for future bulk service. That such a situation should be deliberately created reflects two things: trust in the ability of the firm concerned to deliver the goods on time and remarkable success with the development of the weapon concerned. That weapon was first illustrated last week; it has been given the Service name of Firestreak, and is a product of de Havilland Propellers, Ltd.

In last week's issue we printed a statement by the prime contractor for Firestreak which outlined the genesis and past history of the weapon and described the considerable resources of de Havilland Propellers at such locations as Hatfield, Lostock, Farnworth, Stevenage, and Lakefield. As we pointed out in an appendix to that statement the company bear a weighty responsibility, for any severe failure on their part would have repercussions on the development of such vital aircraft as the later marks of Javelin, the Sea Vixen and the P.1 series, each of which includes Firestreak in its weapon system.

Firestreak is a markedly larger weapon than its counterparts in the U.S.A. Rather than greater range, this is likely to denote a heavier warhead—a major factor affecting the lethality of the weapon at any miss-distance. Body diameter is roughly 9in and overall length a little over 10ft. For comparison, the corresponding dimensions of Fireflash are 6in and 7ft 6in, for Sparrow 6in and 8ft 4in, for Falcon 6in and 6ft 6in and for Sidewinder 5in and 9ft 2in. The American missiles need very good guidance, since their warheads are small. The British missile seems to have the best of both worlds, with good guidance, a proximity fuse and a fearsome warhead.

Propulsion is by a solid-propellant internal motor giving very high thrust for a short time. So that the missile trim shall remain correct during the period of burning, the charge is probably situated near the c.g., suitable pipes being provided to join the

THOUGHTS ON BRITISH MISSILES . . .



Approximate scale drawings of (above): English Electric; Nike Hercules; Nike Ajax; Terrier (right, downwards): Firestreak; Sidewinder; and Falcon. The American surface-launched weapons are depicted without their tandem boost-motors, which greatly increase their length. Scale: 1in=4ft 9in.

English Electric's Stevenage works has this "pan-climatic" test chamber, in which parts or complete weapons can be vibrated under various conditions of temperature, pressure and humidity. The dimensions of the chamber are much greater than the firm's A.A. weapon requires, and may well fit some future ballistic missile body.

chamber to the con-di propelling nozzle at the rear. Unlike the Fairey weapon, Firestreak employs cruciform wings and control surfaces indexed in line with each other. The wings are large and have considerably greater span than those fitted to a test vehicle which was exhibited on the D.H. Enterprise stand at the S.B.A.C. show in 1954. The latter had rectangular wings of very low aspect ratio. The production missile has trapezoidal wings, with swept-back leading edges. The section is parallel double wedge, and each wing is made as a unit which is bolted to the body along massive root attachments.

Compared with the wings, the rectangular, high-aspect-ratio control surfaces are very small. As is usual in contemporary British missiles they are situated at the rear, whereas most American air-to-air weapons employ either canard controls or moving wings. It is of interest to note that the heavy attachments of Firestreak's four wings are faired by long spines which run axially from a point well ahead of the wings to the control surfaces near the boat-shaped tail. It is fair to deduce that these spines cover push/pull rods which actuate the control surfaces by transmitting motion from a hydraulic guidance section ahead of the wings. This is a much better arrangement than having the close-tolerance jacks and valves wrapped around the fiery rocket motor. A photograph published on p. 568 of last week's issue showed a Firestreak undergoing ground testing, and it is pertinent to comment that the front ends of the four spine fairings were removed and stacked alongside.

One cannot comment on whether or not Firestreak starts its flight as a beam-rider, but it certainly employs heat-homing in its terminal phase. The American Sidewinder, also governed by infra-red emanations, has a blunt front end with an almost hemispherical nose. The de Havilland weapon has a front end of great technical interest, but nothing may be said about it at this juncture beyond the indisputable fact that it must provide some form of windows transparent to suitable wavelengths of infra-red radiation. Firestreak is quite a box of tricks, and it requires for its operation several sources of compressed air or electric power. The picture printed last week showed such services plugged in just ahead of the wings. Certain "black boxes" inside the missile have to be warmed up (or cooled down) before the weapon can be launched; a fighter armed with Firestreak would have to provide facilities for this, and other services, and the inputs would need to have special quick-release break-joints so that the weapon could leave its launcher cleanly.

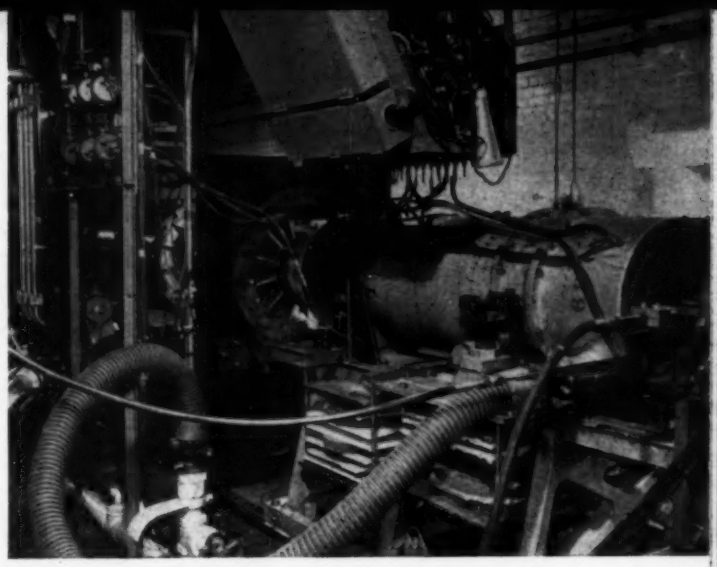
It is worth commenting that the sensitive cell of any heat-homing weapon (see *Flight* for December 7 last, p. 879) responds to any source of radiation with the appropriate wavelength—for example, any body at 750 deg C (roughly the temperature of a turbojet exhaust, without reheat) produces 3-micron radiation. Theoretically, at least, Firestreak could no doubt be induced to home on to a domestic electric fire, or even a cigarette-end at close-enough range. Unless it employs some additional intelligence, it certainly could not distinguish between friend and foe.

It is probable, therefore, that the guidance system must be locked-on to its target before the missile is released. Moreover, should the weapon over-run its target, for any reason—a very unlikely eventuality—some form of self-destruction device must be triggered after a certain number of seconds' flight, to prevent the missile from locking-on to a friendly fighter some miles further on. Firestreak is something which could never be allowed to stray.

No mention has been made of any firms associated with de Havilland Propellers in the development of Firestreak, but a recent report from the Netherlands is not without interest. It states that de Havilland, Mullard, Philips (Netherlands) and the Hollandse Signaalapparatenfabriek were collaborating in the development of guided missiles; and Dr. F. E. Jones, a director of Mullard, read a paper on infra-red which we abstracted in our issue of November 23 last.

Surface-to-air. In April 1953 the then Minister of Defence anounced that "after full consideration the Government has decided that the manning and operation of ground-to-air guided weapons will become the responsibility of the Royal Air Force." By inference one concluded that it would not also become the future prerogative of the Army. It was, therefore, a puzzling situation when, last week, English Electric announced that they had gained a production order for their anti-aircraft weapon while, at the same time, the Air Estimates ignored it and the Royal Air Force announced that it had bought a quite different weapon (Bloodhound, described later).

The explanation is pretty clearly that the previous carefully considered policy has been changed—as have so many of our policies in recent years—and the English Electric weapon system



A heavy-gauge Thor ramjet, powerplant of Bloodhound, running on a sea-level bed at Patchway, with water-cooled tailpipe, spill shield and variable nozzle.

has been bought by the Army. It is a good choice. The missile itself—which has yet to receive its popular name—comes in interchangeable packages which could be tossed into ten-ton trucks, buried in snowdrifts, recovered from sunken vessels and stored amid scorching desert sand. The sections could then be assembled, tested and fired by the most brutal and licentious soldiery still in Her Majesty's service, and English Electric would not be embarrassed by the result. Some hundreds of Servicemen have now become familiar with the weapon and several have expressed their relief at the fact that it is no more complex or difficult to look after than many other items which they have already mastered.

One could conclude from the above that the weapon is crude, or that performance and efficiency have been subordinated to the dictates of reliability. This is by no means so. English Electric have stated that, in overall performance, their missile surpasses the first generation American weapons—Nike Ajax and Terrier—and so may approximate to as advanced a weapon as Nike Hercules. Accompanying drawings (p. 624) give an indication of how the missiles compare size-for-size. The British device is about 20ft long and has a body diameter of some 16in. It is of interest to muse on whether or not it can be fitted with a nuclear warhead. Such a warhead can be fitted to Nike Hercules, and English Electric have said that several types of warhead can be employed by their missile.

A factor of prime importance to any missile weapon system is the extent of its essential ground equipment. Normally, the capital cost of such gear—for carrying, assembling, checking and testing, launching and controlling—far exceeds the cost of each round fired. Base equipment for Nike Ajax, for example, costs over £300,000 for electronics alone, thirty times as much as the missile itself. Although no figures may be cited to support the claim, English Electric can state that their system involves a relatively small amount of ground equipment. This has a cumulative advantageous effect on the reliability, logistics and mobility of the system, quite apart from its relief to the tax-payer.

Bristol's anti-aircraft weapon system—which also includes all ground gear and support equipment—has been designed in co-operation with Ferranti. Unfortunately, the missile itself—which has been named Bloodhound, a name applied to a two-seat Bristol biplane of thirty years ago—may not be illustrated, since it differs in certain important respects from the Bobbin test vehicle (*Flight*, March 29 last).

Bloodhound has clearly been adopted as the first anti-aircraft weapon system of the Royal Air Force. To a considerable degree its adoption will not disrupt the traditions or logistics of that Service, since the Bloodhounds can be treated as small twin-engined, all-weather fighters—burning kerosine fuel—which just happen to have no pilot. One wonders if the production rounds will be painted in Fighter Command colours, since even Firestreak bears Service roundels.

Powerplant of the twin-engined missile is the Thor ramjet, developed by Bristol Aero-Engines. This unit has a diameter of 16in and, since diameter is a fair index of ramjet performance (for equal Mach number and altitude), it follows that Bloodhound cannot be anything like so large as the U.S.A.F's Bomarc, which has twin 28in Marquardt engines. The latter weapon has a range of the order of 280 miles and can carry a nuclear warhead; its launching weight is 5,000 lb, or 8,500 lb including its big booster. The fact that Bloodhound cannot, by reason of its smaller size, have comparable range reflects the fact that it has been tailored to the defence-problems of the United Kingdom—or possibly the R.A.F.'s bases overseas—whereas Bomarc will have to cover most of the United States, a matter of 3m square miles.

This leads to discussion of such matters as guidance, early-warning time, types of target, area to be defended, weapon performance, and fundamentals of a like nature. It is known that we in Britain enjoy the benefits of the finest overall radar cover in the world. Our control and reporting organization is also completely integrated with the massive networks of Canada and the U.S.A. and NATO, from North Cape to the Mediterranean. We may therefore expect to have at least several minutes' warning of any impending attack, even one involving wingless weapons.

Our island is, however, a densely packed piece of real estate, and the air-space above is also relatively busy. Under such conditions, any missile system which requires continuous tracking of either the missiles or their targets can hardly be a practicable proposition. It was, therefore, not surprising when it was officially stated that American anti-aircraft weapon systems (such as Nike Ajax) did not fit our electronic environment. Our weapons, such as Bloodhound and the English Electric system, must use either semi-active homing, or—if we are really advanced—fully active or passive systems. Strength is lent to this belief by the statement that our weapons "could be used within the defensive organizations" of foreign countries.

Certainly semi-active homing is employed in the first-generation Bloodhound system, for the Memorandum to the Air Estimates says so; and the same source states that "highly effective" H.E. warheads will be used, the intention being to replace them later by atomic warheads.

Semi-active homing involves intense target illumination by ground radars and homing of the missile on to the reflected radiation. Any given target has a fixed response to such illumination, and the problem resolves itself into one of echo-area, target speed and height and overall warning time. If a missile battery has *X* seconds warning, the distance to which they can throw their projectile depends on its speed; so, to some extent at least, increasing flight Mach number from say 1.9 to 2.3 or from 2.3 to 2.8 (random figures) is more important than putting in more tankage or extending endurance.

Air-to-surface. Bomber Command's medium bombers are to be armed with a stand-off bomb. This is a self-propelled missile which can be carried by the bomber to within perhaps 100 miles of the target and then launched. The bomber runs for home—supposedly outside defending missile screens—while the missile flies on under self-contained guidance (star-tracking, doppler, inertial or a mixture of two or more of these systems).

At present Britain has a stock-pile of free-falling kiloton (atomic) bombs, but the stand-off weapon, with a megaton (thermo-nuclear) warhead, would make our aircraft vastly more effective. Avro are stated to have been associated with the development of such a device, which should be available earlier than ballistic missiles capable of doing a similar job.

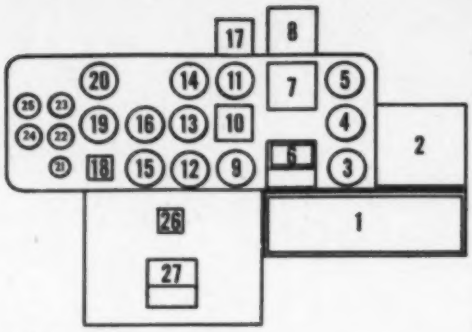
Surface-to-surface. In this field the dominant weapon is the long-range ballistic missile, and we have decided to take one of our famous "jumps" by missing out the first generation of such weapons. From America we are to receive quantities of a selected IRBM—whichever wins the Thor/Jupiter competition—and will make warheads for these missiles ourselves.

Decision to accept a foreign weapon has its pitfalls but the alternative is "nothing at all" (this is the official view). We are, however, retaining our ballistic-missile teams as coherent entities, and many companies—including, so it is said, English Electric, de Havilland Propellers and Vickers—are intensely engaged in the basic development of one or more weapons of around 2,000-miles' range. It is to be hoped that the morale of the engineers concerned is good; there is nothing more disheartening to a development team than for those engaged upon it to have little hope of being allowed to deliver the goods to the user, and this must not again happen to our ballistic-missile workers.

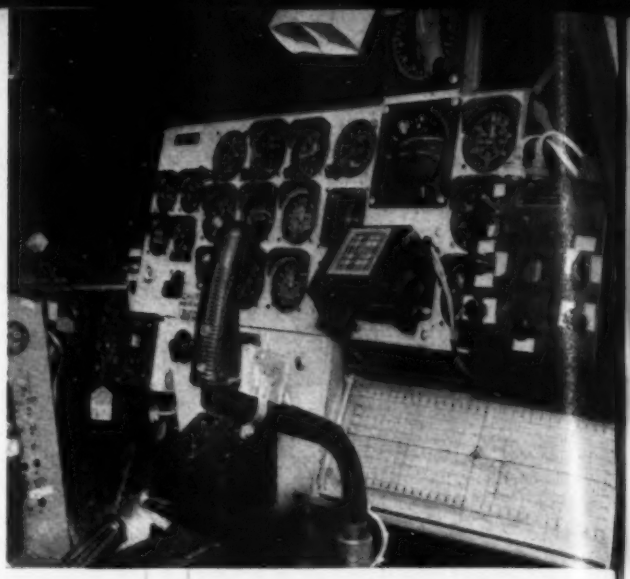
U.S. GROUND-LEVEL EJECTION

THE U.S. Air Research and Development Command has stated that a ground-level automatic ejection system for pilots has been developed and tested in America. It consists of a standard ejection-seat modified with a pneumatic separator to push the seat away from the pilot immediately after ejection. A lanyard attached to the seat simultaneously pulls the parachute rip-cord. In tests, dummies reached heights of 65ft after ejection and landed safely in an upright position. The ground-level system is to be standardized for all appropriate U.S.A.F. aircraft.

All new Martin-Baker ejection seats for the R.A.F.—and presumably for the U.S. Navy as well—have been fitted with ground-level mechanism for the past eighteen months. A successful live demonstration of a ground-level ejection was made by S/L. J. S. Fifield at Chalgrove shortly before the S.B.A.C. display in 1955.



1 Decca plotting board.
2 Kenyon Transitometer control box.
3 Revolution indicator.
4 Manifold pressure gauge.
5 Airspeed indicator.
6 Kenyon Transitometer (ground speed indicator).
7 Attitude indicator.
8 Heading indicator.
9 Instantaneous rate-of-climb indicator.
10 I.L.S. cross-pointer indicator.
11 Absolute altimeter.
12 Red Decometer.
13 Green Decometer.
14 Barometric altimeter.
15 Oil temperature gauge.
16 Cylinder-head temperature gauge.
17 Groundspeed indicator.
18 Transmitter channel selector.
19 Revolution indicator.
20 Compass system indicator.
21 Load meter.
22 Oil pressure indicator.
23 Carburettor air temperature.
24 Ignition switch.
25 Fuel gauge.
26 Decca control box.
27 Co-ordinate control box.



The cockpit of the experimental Bell 47H, showing the Kenyon ground-speed indicator, Decca plotting board and the flight instruments.

Helicopter Blind Flying

Bendix-Decca-Bell System Demonstrated

THE Bell Helicopter Corporation recently publicly demonstrated their helicopter blind-flying equipment in two Bell 47Hs at their Fort Worth factory. The Pacific Division of Bendix Aviation Corporation, who have the American Decca Navigator licence, have been working with Bell in developing the system. A Decca chain has been set up in the Fort Worth area and, by the use of a master and two slave stations, position accuracies of the order of 20ft have been obtained. The airborne equipment carried in the helicopters weighs no more than 40 lb and includes a fixed plotting-board on which the helicopter's track is marked by a moving pen. (On the English Decca Flight Log both pen and map move.)

To go with the Decca Navigator, Bendix have developed a sonic altimeter which gives height readings from ground level (or from obstructions) up to 150ft to an accuracy of six inches. Decca, the sonic altimeter and I.L.S. are stated to make it possible to accomplish blind landings in any selected place. To ease the problem of avoiding ground obstructions, the Decca plotting-board is marked with the main hazards within the operating area; a complete map is not, apparently, used. By this means a plotting board marked with Decca position lines can be used immediately after a Decca chain is set up in the field. Main obstructions are surveyed and marked on the board, but special map projections are not required.

In addition to the equipment mentioned above, the two helicopters used in the trials carry a ground-speed measuring device developed by Kenyon Laboratories, Inc., which shows movement over the ground on a curiously marked screen indicator. Attitude and course information appear to be supplied by a normal artificial horizon and a gyro-magnetic compass system. It is not explained how the horizon deals with the particular attitude-indicating requirements of helicopters.

Bell nevertheless claim that completely blind flying at night or in cloud is now possible and that the equipment is available for adaptation to specific installations. They claim that a pilot can fly "to any spot within a 100-mile area and make an instrument approach to within ten feet of the ground without looking outside the helicopter cabin." They also reaffirm that the Decca system is not limited to line-of-sight reception, is light in weight, and gives accuracies of a very high order.

MILLING-MACHINE DEVELOPMENT

AS a joint project under U.S.A.F. contract, the Research Laboratories Division of Bendix Aviation and the Martin Company have produced a 50-ton milling machine designed from the start for use with a punched-tape numerical control system. Bendix carried out the design of the complete unit and sub-contracted the manufacture of the machine to Kearney and Trecker Corporation of Milwaukee. The completed machine is to be brought to the Martin factory at Baltimore in June and will be used for the automatic milling of large forgings used in the TM-61 Matador and the P6M SeaMaster flying-boat.

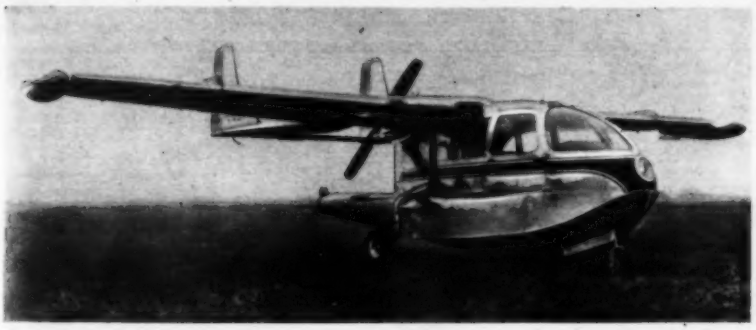
Numerical control, which implies automatic punched- or magnetic-tape control of machines, has in many cases been applied to existing drilling and milling machines, but the new Martin-Bendix machine is claimed to be the first of its size designed from the outset to utilize such a system. For this purpose the machine has been given extra rigidity in order to take full advantage of the increased speeds and feeds which the method is able to maintain.

The particular advantage of this type of automatic miller is that it greatly reduces the time required to set up the work manually for each new operation. With numerical control a special computer is used to derive instructions from a blueprint and to impose them on the control tape. The machine operator then only has to set up the part for cutting, load the relevant control tape and change the cutters during operation. Rapid increases in production output are possible because new tapes can be prepared in a matter of hours and sent out to a number of controlled machines in other factories. This avoids the extensive and lengthy preparations now required before a new production source can be established. To facilitate rapid expansion, certain design elements will be standardized and coded for storage in the memory unit of the control system. Thereafter a call-out symbol or equation constant included in the numerical design of a given part will suffice to initiate the machining operation.

DOCUMENTING THE 1957 SKY

IT was an admirable idea of the Esso Petroleum Co. to make a film tribute to all who have played a part in Britain's air defence during the last two decades, but unfortunately the result—*The Deep Blue Sky*, made for Esso by Technical and Scientific Films, Ltd., and given a preview in London on April 8—is less successful than it might have been. A stronger theme is needed to hold together such assorted "characters" as the Hunter, Javelin, Valiant, Vulcan and Victor, especially as they are by now familiar shapes.

Certainly the photography—all of it in colour, and most of it air-to-air—is pretty good, considering occasional difficulties imposed by security; and it is of special interest to see the Valiant's refuelling probe out in flight and Roly Falk rolling his Vulcan as if it were a Tiger Moth. But a good underlying "story" is lacking; the opening Battle of Britain Sunday sequence is rather wooden, and thereafter the film tends to become a somewhat formless procession of aircraft, though each is impressive individually and as a straightforward pictorial record of the chief British military aircraft in 1957, *The Deep Blue Sky* forms a useful and attractive documentary. It is 16 mm sound, lasts about half an hour and is on free loan. (Applications to the Manager, Aviation Department, Esso Petroleum Co., Ltd., 101 Piccadilly, London, W.1.)



The Nord 2501 Noratlas (upper picture) is the first of a batch for Germany. The engines, as in most other Noratlases, are Bristol Hercules built under licence by SNECMA. The amphibian is the Italian Fiat-Nardi FN-333 four-seater, with 240 h.p. Continental engine.

AIRCRAFT INTELLIGENCE

U.S.A.

Lockheed F-104 Starfighter. A Starfighter is to be fitted with Sidewinder missiles for test at the Naval Ordnance Test Station, China Lake, California, where the missile was developed.

North American T2J. So designated is a forthcoming North American tandem-seat trainer for the U.S. Navy. A mock-up already exists. The Westinghouse J34 turbojet has an under-fuselage intake close behind the nosewheel and should give a speed of 500 m.p.h. Gross weight will be about 9,000 lb.

Canada

Jet Mentor Licence. The Canadian Car and Foundry Co., Ltd., of Montreal, has made an agreement with the Beech Aircraft Corporation, of Wichita, for the rights to manufacture the Beech Model 73 jet trainer in Canada. A Beech statement reads: "Both the Canadian Car Co. and the Beech Aircraft Corporation believe that this aircraft has a very good chance of meeting the exacting requirements of the Royal Canadian Air Force. The airplane will be in Canada for two weeks beginning April 28 when R.C.A.F. pilots will evaluate its performance as a suitable replacement for the Harvard (Canadian counterpart of the U.S.A.F. T-6 Texan)."

France

Atar Volant. The SNECMA group announce that the V.T.O. testbed, known as the Atar Volant or Atar P.1, which until recently has been remotely controlled, has been flying since April 8 with a pilot. In the P.2 model, test pilot Auguste Morel will be provided with an ejector seat, an instrument panel and conventional controls for directing the aircraft.

Max Holste 1521 Broussard. Orders for eight civil Broussards have lately been received. Six are for the Aerotechnique company of Algiers, and two are for Air-Gabon, which has its headquarters at Port-Gentil. On the military side it is learned that the first Broussard liaison/observation squadron, ELO 3/4, stationed in North Africa, has completed more than 7,000 hours' flying in less than ten months. Of the Argentine order for ten, the fifth should now have left France.

China

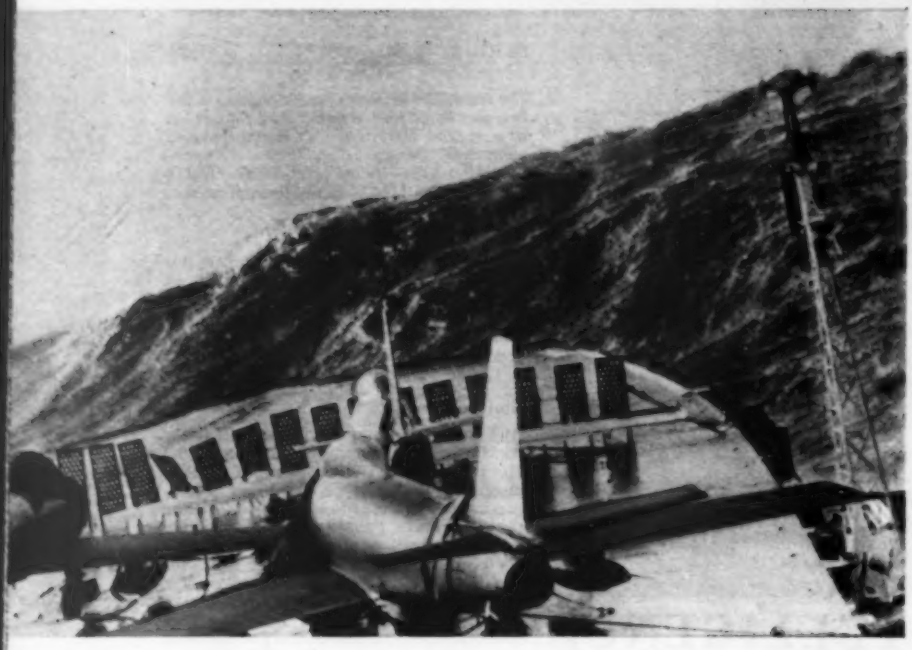
Polish Gliders. A "Polish-built glider factory" is soon to start operation in Shenyang, China, according to a Peking report. The same source declares that 500 Polish-designed gliders will be built a year and that the figure will be stepped up to 1,000.

Switzerland

Military and Civil Flying. The Swiss Air Force is continuing evaluation of the Hunter F.6 and the Sabre 6. Two machines of each type are being tested, particularly in the ground-attack role. The third prototype FFA P-16 has been flying since mid-April, and the second prototype has been handed over to the Air Force for evaluation. Recent figures show that at the end of last year 581 civil aircraft were registered in Switzerland, including four helicopters, 173 sailplanes and five balloons.

MIG-17 (Egypt)
(Improved VK-1 Turbojet)

Span	...	...	36ft approx.
Length	...	...	38ft approx.

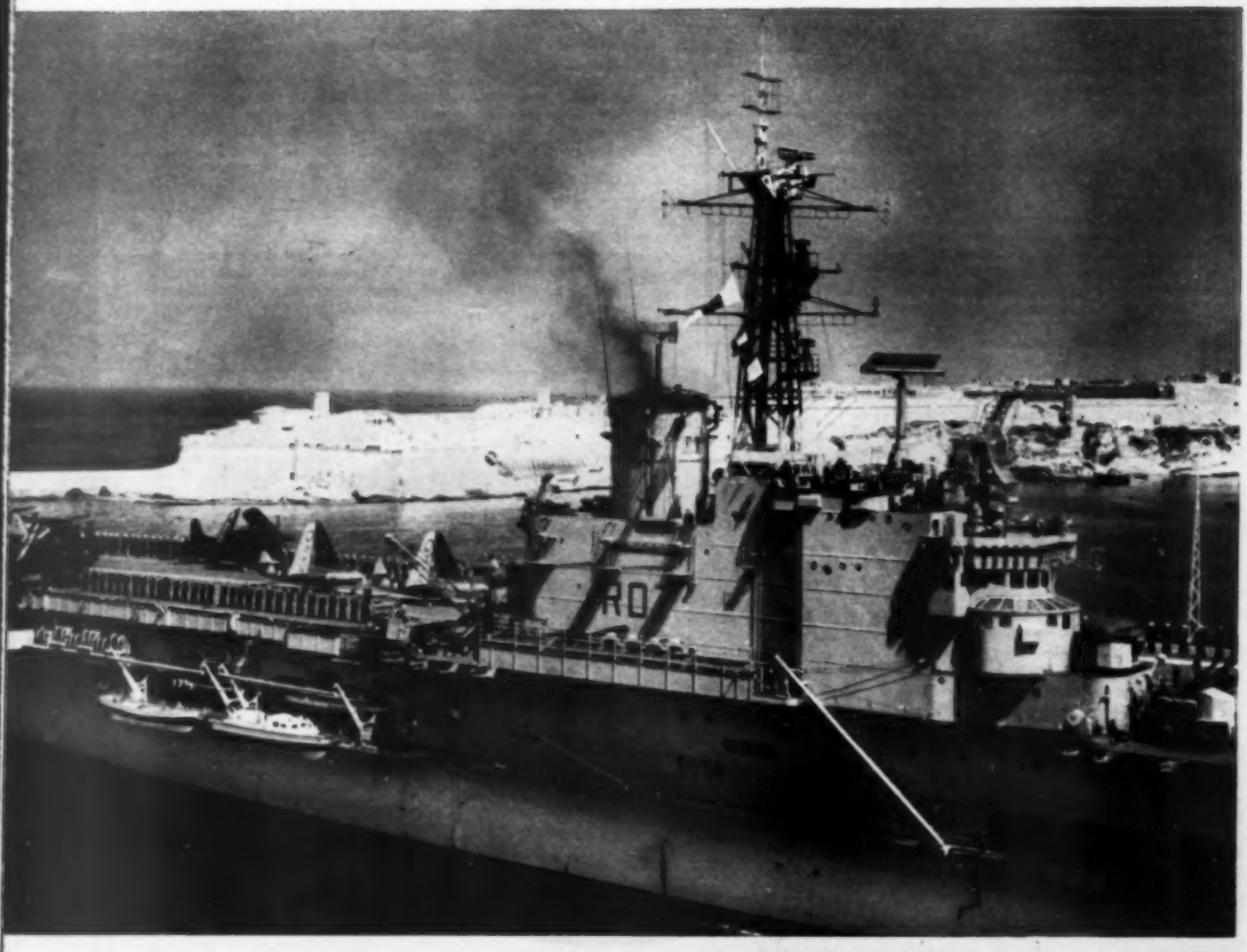


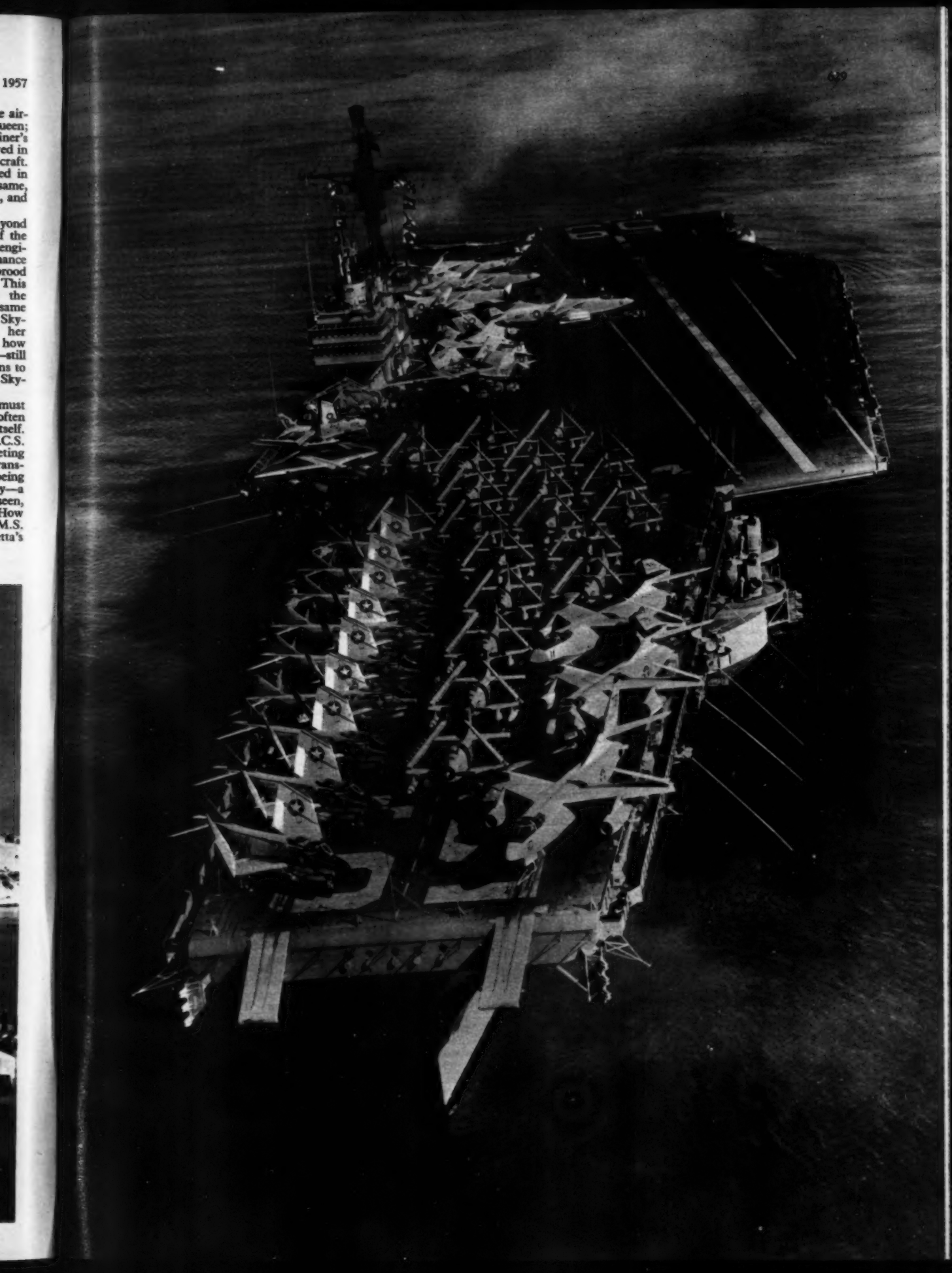
BUSINESS IN GREAT WATERS

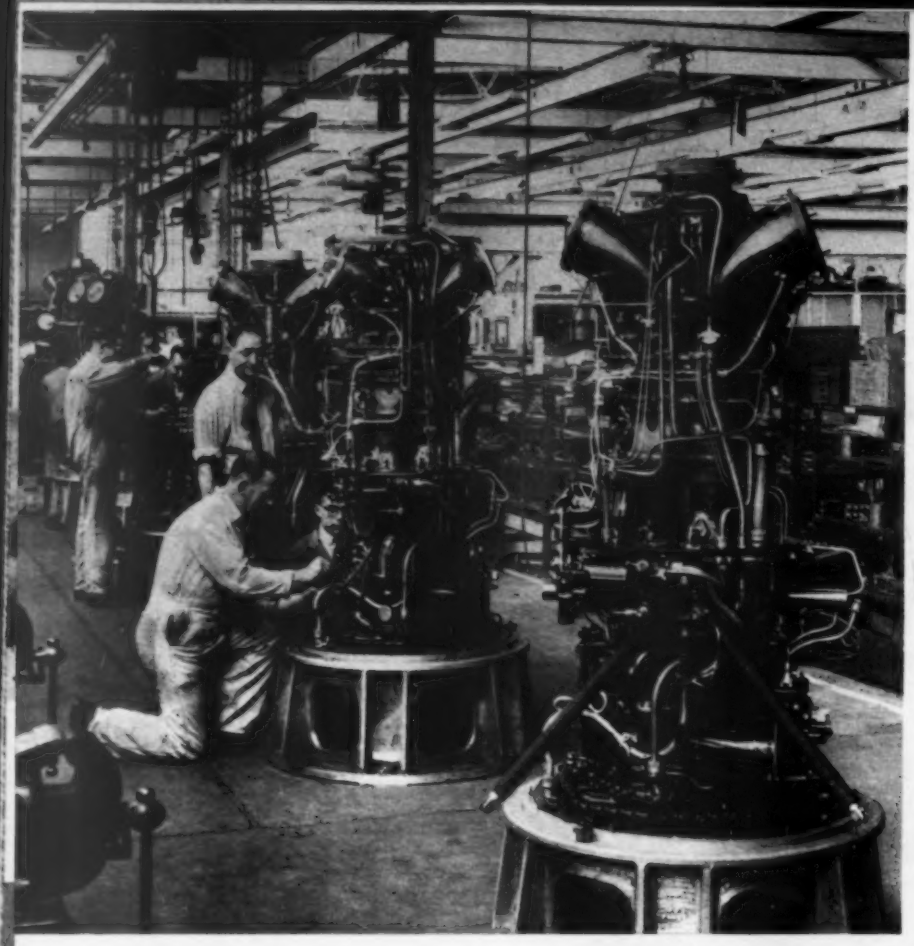
IF the liner is a lady then the aircraft carrier is assuredly a queen; for not only has she the liner's stateliness, but she is far removed in character from commoner craft. And if her character is revealed in irregularity of feature, the same, surely, was true of Elizabeth I, and many another empress.

Be that as it may, it is beyond cavil that the carrier is one of the noblest expressions of modern engineering skill, and her dominance over even the greatest of her brood is proclaimed on the right. This carrier—U.S.S. *Forrestal*—is the mightiest of her kind; and the same can be said of the Douglas Skywarrior bombers ranged on her flight deck to port. But how subordinate do these appear—still more so the McDonnell Demons to starboard and the Douglas Skyraiders ranged amidships.

Like every queen, the carrier must have her times of testing, and often these are conflicts with the sea itself. At such a time is seen H.M.C.S. *Magnificent* (left). She is meeting heavy weather on her last transatlantic crossing before being returned to the Royal Navy—a voyage which served, as can be seen, for the ferrying of Sabres. How tranquilly, by contrast, does H.M.S. *Albion* (below) glide into Valetta's Grand Harbour.







NAPIER GAZELLE

A 1,000 to 2,000 h.p. Free-Turbine Unit

FOR more than ten years the long-established firm of D. Napier and Son, Ltd., of Acton, London, have devoted a substantial proportion of their development effort to the evolution of a series of axial gas turbines for aircraft propulsion. In general the company have concentrated upon units in the low-to-medium power range, and, with the aid of a well-equipped testing station in Liverpool, have evolved a family of compressors which beat all their contemporaries for overall efficiency and work per stage.

Starting with the 1,500 h.p. Naiad, the company evolved the 3,000 h.p. Eland, the 800-1,200 gas horsepower Oryx turbo-gas generator and the unique reciprocating/gas turbine Nomad *. Each of these units was designed for a particular type of application, and the Oryx in particular was specifically intended to provide a flow of gas suitable for helicopter tip-drive applications. The engine was neat and attractive, and it fully met all its specified performance requirements. In 1953 the Bristol Aeroplane Company suggested to Napier that a free-turbine, shaft-drive Oryx could be matched with a development of the Bristol 173 tandem-rotor twin-engined helicopter, and Napier accordingly prepared the NOr.2 and 3 projects, respectively of 650 and 900 s.h.p.

The former project was considered suitable for a commercial derivative of the Bristol 173, and the latter was tailored to the projected Bristol 191, a heavier tandem-rotor machine intended for the Royal Navy. The requirements for an engine for the 191 were severe for, although 900 s.h.p. was adequate for all normal twin-engine operation, a one-hour power of 1,100 s.h.p. was postulated, plus the rather unusual request for an emergency (2½-minute) rating of "at least 1,260 s.h.p." for the one-engine-cut case. Such powers were some 50 per cent greater than those of existing Oryx units.

After careful consideration, Napier decided that the power requirements for the Bristol 191, and the even more advanced Model 192, could best be met by a new engine with a mass-flow rather greater than that of the Oryx. A major factor in this decision was the availability of an existing, and fully proven, compressor with suitable characteristics. The Nomad compound engine employed a 12-stage unit with a constant tip-diameter of 10.44in and a maximum pressure ratio of 8.25:1. This unit had been based on aerodynamic data from the 11.32in research compressor evolved at the Liverpool test station, and had a sufficiently good background for guaranteed performance to be quoted even when modified to suit the new engine. In fact, it was decided to discard the twelfth stage and thus obtain a light and efficient assembly capable of delivering 16 lb/sec at a pressure ratio of 6.37:1. Early in 1954 the essentials of an engine using such a compressor were finalized, and the Ministry of Supply issued a design and development contract. The engine was named the Gazelle.

Serious design started in June 1954, and the first unit ran on the bench—and was accepted—on December 3, 1955. On December 14 it delivered its full brochure performance of 1,260 s.h.p., and by August 1956 over 2,000 bench hours had been run, including over 1,000 on one unit. This is partly due to the fact that the company had an established compressor, but it is worth commenting that the business of designing gas-turbine aero engines is today much more predictable than it once was. Napier, like other companies, can now embark on most designs with confidence and achieve a successful result in the minimum time.

It is appropriate now to describe the basic Gazelle of NGa.1 rating (throughout the description it is assumed that the engine is mounted vertically). Further notes on the development and applications of the engine are appended as the concluding paragraphs.

All the immediate applications of the Gazelle concern rotary-wing aircraft, and the engine has therefore been planned for installation at any angle (provided the intake is not higher than the hot end of the engine). This provision ensures that liquid fuel present inside the engine after a wet start cannot drain into hot areas, and so present a fire-risk. In practice, it has been found that a vertical Gazelle blows all such fuel out of the exhaust trunks during the run-down of the compressor.

Ram intake ducting is not employed in present installations, the engine being mounted in a plenum chamber which provides unrestricted flow around the entire periphery of the circumferential intake. The latter is formed by a single casting in R.Z.5 (D.T.D.748) magnesium zirconium alloy. It is worth commenting that Napier have long made considerable use of the lightweight alloys of low specific gravity produced by Magnesium Elektron, Ltd., and, notwithstanding its considerable size, the Gazelle intake casting has a finished weight of no more than 45 lb. The casting virtually consists of a pair of discs joined by six radial struts. As described later, five of these struts are heated by the engine oil system which is also circulated through jackets beneath the underside of the casting to prevent icing, and the sixth spat is heated by i.g.v. air. The casting terminates at the entry to the axial compressor and carries a row of variable-incidence inlet guide vanes which are automatically controlled (normally through a range of about −10 to +35 deg) to provide the correct entry-swirl at all conditions of engine r.p.m.

These guide vanes are formed from thin beryllium-copper sheet wrapped and brazed over a length of wire, so that compressor-delivery air at 200-220 deg C can be tapped—through external pipes—and used to heat the hollow vanes (see detail sketch, page 634). The beryllium-copper, incidentally, is hardened to a spring temper after being worked soft, and the vanes are inserted into cast ends of the same material which not only have good heat-transfer properties but also act as suitable dry bearings, running in rings carried by the intake casting. Blade incidence is controlled by a ring at the outer ends of the vanes,

**The four engines mentioned were described in the following issues of "Flight": Naiad, August 12, 1948; Eland, July 23, 1954; Oryx, August 5, 1953; and Nomad, April 30, 1954.*

slots in the ring moving an eccentric pin on each vane end-plate.

As already noted, the compressor has 11 stages, and the mechanical design can be followed clearly from the illustrations. All blading is of aluminium-bronze to D.T.D.197 (D.N.S.210), a material, with good resistance to both corrosion and fatigue, to which Napier have adhered faithfully in all their recent gas-turbine designs (it is actually supplied by Langley Alloys as Hidurax). All rotor blades are secured by fir-tree roots to discs splined to the compressor shaft. The discs for stages 1, 8, 9, 10 and 11 are of Rex 448 stainless steel and the remainder are of aluminium alloy. The shaft itself is of S.106 stainless steel and the stub-shaft at the lower end is made separately (in the Eland the entire assembly is a single forging). The stub shaft is ground to an interference fit inside the compressor shaft and is pushed in against a ring of copper brazing material. The complete assembly is then heated in a furnace so that the brazing alloy travels down the interference fit. This construction greatly eases the machining and general manufacturing problems and has been made possible largely by the fact that the assembly does not have to transmit power for a propeller.

The compressor casing is cast by Sterling Metals, Ltd., in Magnesium Elektron Z.T.1 magnesium-zicronium alloy. Each half-casing accommodates magnesium and aluminium-alloy carrier rings for the stator blades, the outer ends of which (incorporating lightening holes) are pushed into slots in their retaining rings and held by overhanging lugs bearing on the outer diameter of the ring. The stator assemblies are continuous over each 180-deg casing section and the blade-retaining rings each accommodate from one to three rows of blades. The upper (outlet) end of the compressor casing is bolted to the main engine support plate. Following typical Napier practice this unit is the backbone of the whole engine and incorporates four engine mounting pads. It is a one-piece casting in Z.T.1 incorporating expanding diffuser passages leading to the six combustion chambers.

Previous Napier engines have featured individually removable cans, but the life of combustion sections has improved so much in recent years that provision for inter-overhaul can removal is not now considered a major advantage. In the Gazelle, therefore, the assembly comprises six flame-tubes mounted in outer tubular chambers welded to front and rear plates to form a single rigid unit capable of transmitting all structural loads from the turbine section. This has allowed the external tubular skeleton of previous Napier engines to be eliminated.

Nimonic 75 is the ruling material in the combustion section, which is manufactured by Lucas and designed by them in conjunction with Napier, Briggs Motor Bodies manufacturing the bulk of the turbine sheet-metalwork. A bolted break-joint is provided at the lower end of the assembly, which allows all six cans to be withdrawn together should this be necessary. Upstream-injection burners are employed and the overall geometry of the system closely follows previous Napier practice. A small hole is drilled through the point of each can nose-fairing to prevent fuel from collecting there after a wet start.

Two stages of blades are fitted to the compressor turbine, the mechanical design of which is clarified by detail sketches. Both discs are of Rex 448 and are splined to an S.106 forged shaft which has internal gear teeth at its lower end engaging in the corresponding gear on the compressor extension shaft. The shafts can be parted at this joint when the engine is "broken" at the main support plate. Rotor-blade material is Nimonic 100 for the first stage and Nimonic 90 for the second; each blade has

The combustion system described in the text of col. 1 comprises individual chambers formed into a single rigid unit capable of transmitting major structural loads. In practice, the flame-tubes are withdrawable together and not individually as shown.

a conventional fir-tree root permitting limited rock, retained by a stop tang at the front of the root and a bent piece of Nimonic 75 wire holding the rear. Extended-root blades are employed, with platforms forming a sealing ring. A scroll-type seal is formed from diagonal grooves machined on the front faces of the stage-1 blades. A point of particular interest is that the damping of the blades is increased by Nimonic wire laced through the extended root sections, out of the gas stream. Although not regarded as essential, this type of damping imposes few penalties and increases in effectiveness with r.p.m. above a known lower limit out of the supposed range of excitation. The wire is so arranged that it yields over two blade pitches.

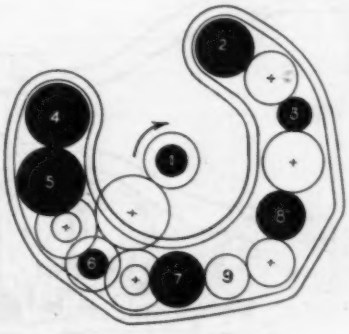
Nozzle blading is cast by Napier's own foundry in aged X-40 steel. The first-stage nozzles are fitted into slots in the inner and outer rings, each blade being located on the side faces of the axial slots in the ring (see sketch, page 634). The inner and outer rings are free to float on radial dogs. The blades are peened in place so that the assembly is virtually treated as one unit.

Nozzle blades for the second stage are attached at platforms on their outer ends which are located on their side faces and held down firmly in their retaining rings by X-40 conical washers and Durahete nuts locked by spectacle tabs. Several of the inner platforms have swinging-link attachments which locate the inter-stage seal concentric with the shaft.

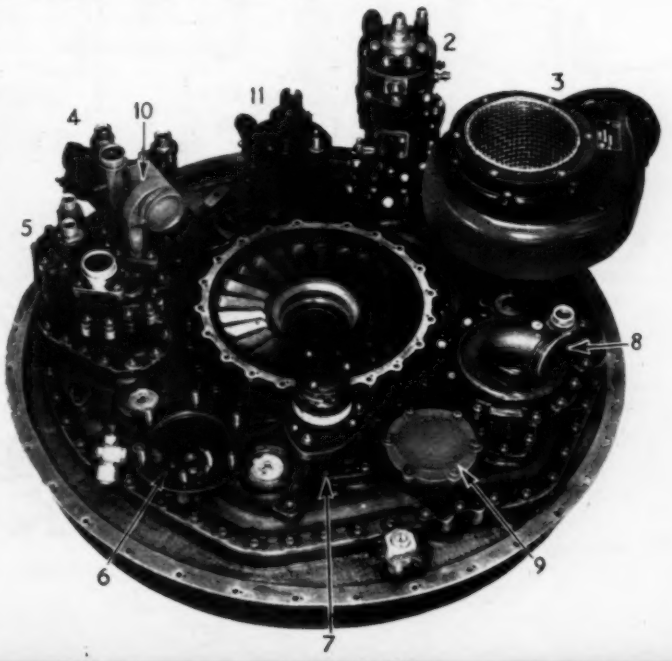
The power turbine is mechanically independent and is a disc forged integrally with its extension shaft, which is provided with internal splines mating with a quill-shaft which transmits the drive to the reduction gear. The Nimonic 90 blades each have a stop-tang on the upper (or rear) ends of their roots which is pressed against the Rex 448 disc by the pressure-balance piston mounted immediately above. The complete assembly is carried off the casings of the compressor turbine and can be removed as a unit.

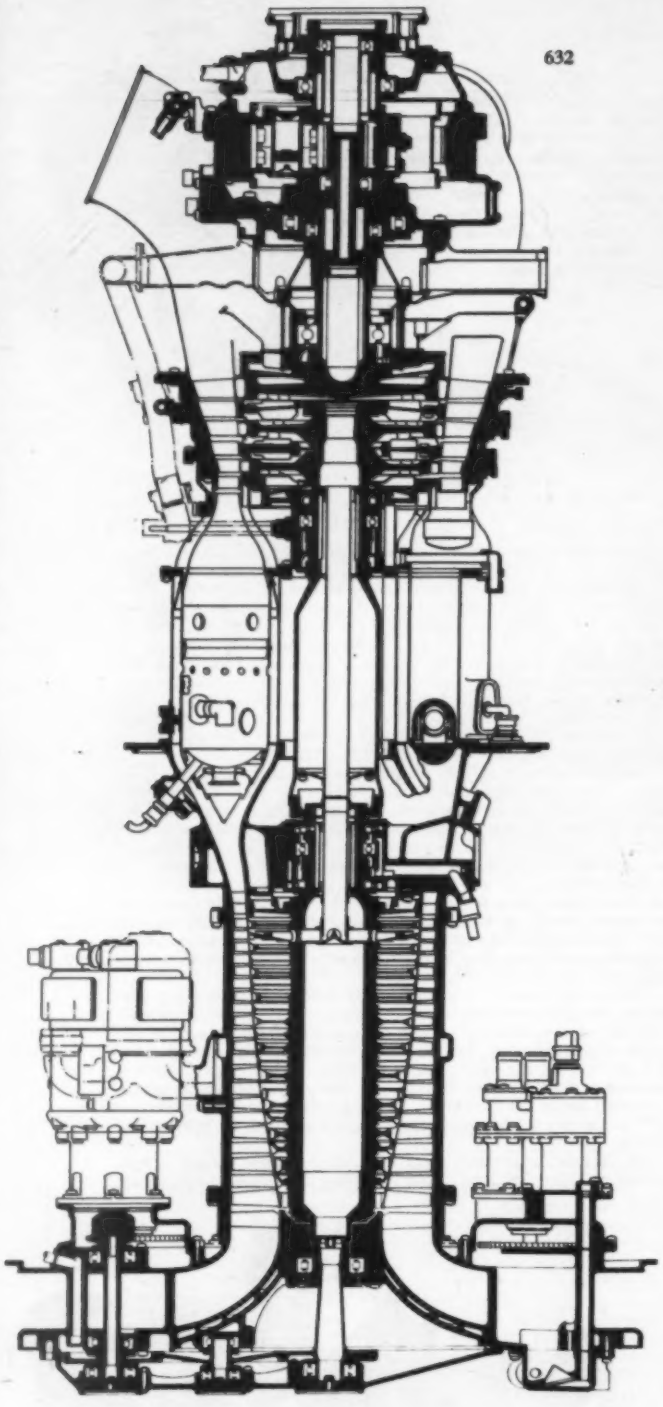
All Gazelles at present being built have a single-stage epicyclic reduction gear of 6:1 ratio, incorporating an integral torquemeter,

In its helicopter applications, the Gazelle incorporates a large-diameter intake casting upon which is mounted a peripheral "banana plate" carrying a row of accessories. The general appearance of the unit, together with the variable-incidence inlet guide vanes, is shown in the photograph, a key to which is provided by the drawing and list below.



1 Shaft.
2 Fuel pump.
3 Oil cooler fan.
4 Oil pressure pumps.
5 Oil scavenge pumps.
6 Starter.
7 Tachometer gearing.
8 Centrifugal breather.
9 Spare.
10. Oil/air separator.
11. Fuel filter.





The longitudinal section depicted at the left forms a useful complement to the perspective drawings on the facing page. Items clarified are the types of bearing fitted, disposition of main stress-bearing members and the gas-flow through the engine. The outlet ducting for the exhaust gas is turned through 90 deg on the right-hand side..

NAPIER GAZELLE . . .

of the type which we described (July 23, 1954), around the periphery of the annulus gear in relation to the Eland. The reduction gear is housed in a two-piece casing of Z.T.1 alloy which is mounted on a fabricated spider assembly. The latter, which incorporates the main oil sump, is attached to the turbine section by forged stainless-steel brackets with pinned joints at either end. A detail sketch on p. 634 shows the whole assembly.

Exhaust gas is carried away through a bifurcated trunk passing on either side of the reduction gear. Originally each trunk ended in an oval outlet, but installational considerations in the Bristol 192 led to the adoption of a double-bifurcated design with four circular nozzles, which actually gives improved performance.

An accompanying diagram alongside shows most of the principal flows of cooling air. Main rotor bearings are all by Hoffmann. The "any-angle" characteristic of the Gazelle required the development of leak-proof bearings, and sixth-stage filtered bleed air is accordingly fed to an annulus above and below the main rotor bearings and passed between labyrinths to pressurize the bearing and retain the oil. Each bearing has its own sump, which is drained by its own gear scavenge pump mounted on the intake casing. A lifter pump, also mounted above the intake, raises the oil to the main scavenge line under the reduction gear from which it flows through a mesh filter to the main scavenge pump. It is then de-aerated and passed around hot jackets on the underside of the intake casting and through four of the intake spats (a fifth spat, out of the total of six, is heated by the oil drawn to the lifter pump).

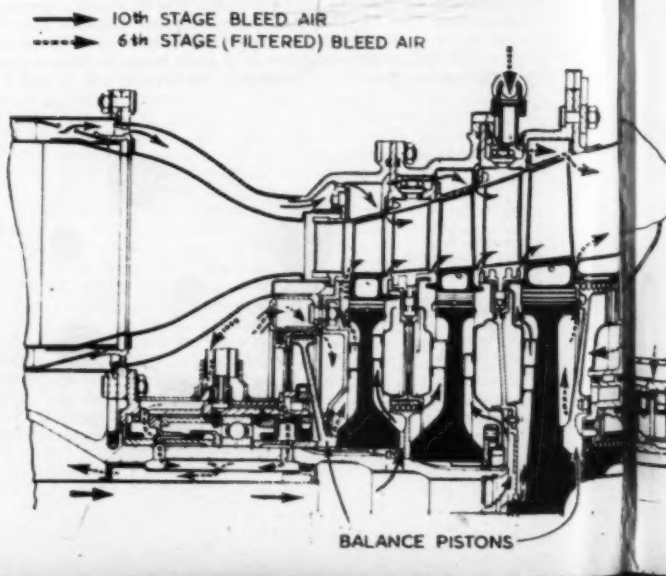
Cooling for the front face of the first-stage turbine disc is provided by air tapped from the compressor diffuser passage into a rectangular-section annular gallery, from which it escapes through three tubes passing up the inside of the combustion section. From the balance-piston chamber the airflow is metered through the bore of a sheet-brass ring carried by a machined disc of Crown Max steel behind the turbine balance piston, and thence passes up the rotor disc under the guidance of stitch-welded scrolls.

Cooling for the next four disc-faces is provided by tenth-stage air tapped at the inner radius of the compressor rotor, through a static collector which destroys the free-vortex flow and so increases the total head. This air passes into the main drive-shaft (which is broken in line with the main engine support plate, the joint being sealed by a silicone-rubber ring) and finally escapes through radial holes in the turbine shaft or through the end of the shaft itself. The final disc-face is scarcely hot enough to require special cooling, but is ventilated by sixth-stage bleed air passed through external bleed pipes leading to the power-turbine balance-piston chamber above the turbine, the bore of the balance-piston allowing a leakage of air over the rear face of the power-turbine disc.

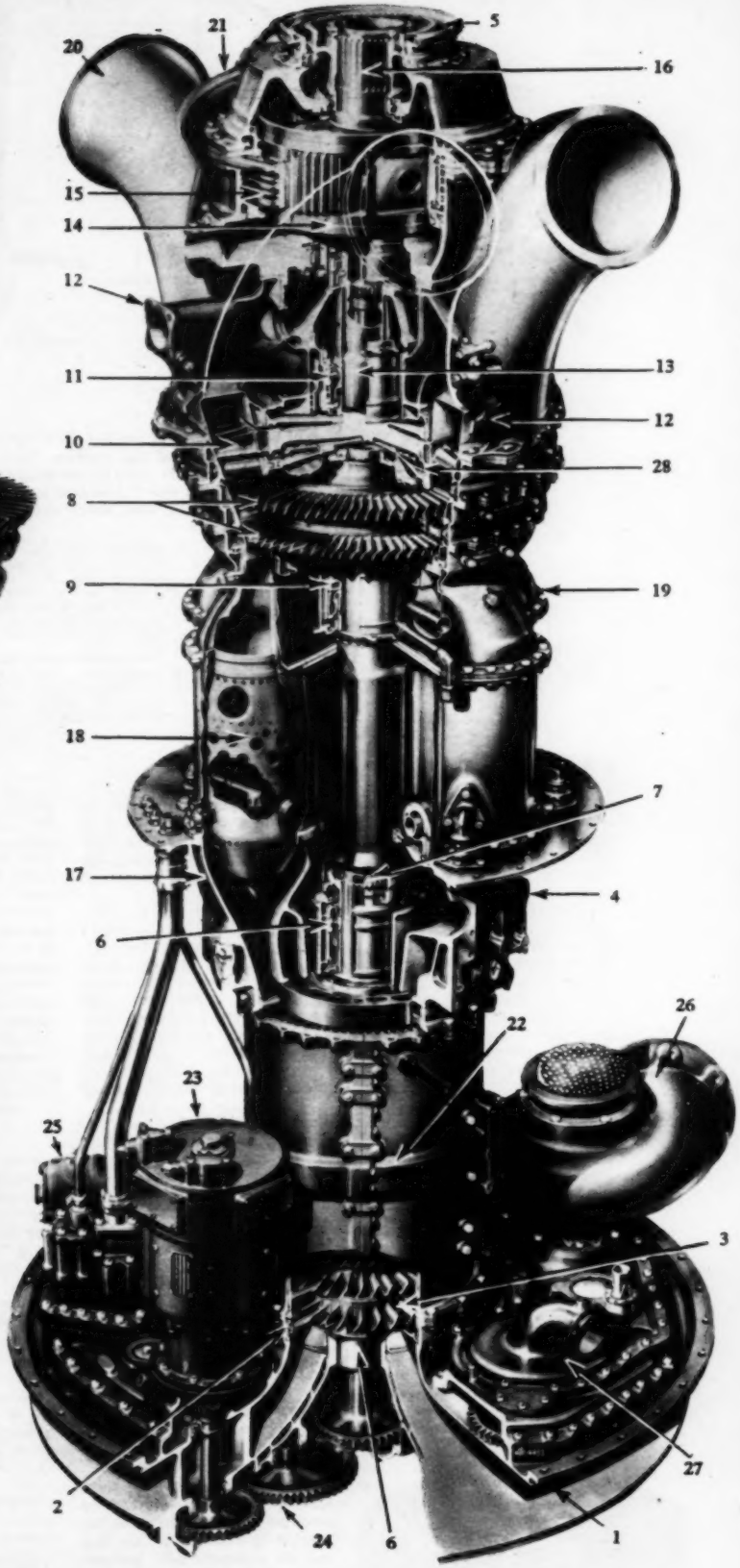
Secondary air from the combustion chambers is taken *via* the turbine inlet casing to cool the first two shroud sections. A proportion of the air leaks to the gas stream through a gap ahead of the second-stage nozzles. The remainder continues over the second-stage segments and leaks at the front of the third-stage nozzles. The third-stage shrouds are cooled by the sixth-stage compressor air fed from the external gallery at six places over the power-turbine nozzles and segments, the latter having small holes at their upper ends from which the air finally enters the gas stream.

In the Gazelle, Napier have not employed shrouded turbine rotor blades, but have very successfully aimed at reducing tip clearance on the turbine rotor blades by controlling the diameter of the casing to a much finer tolerance than has hitherto been possible. The shrouds themselves consist of twelve segments

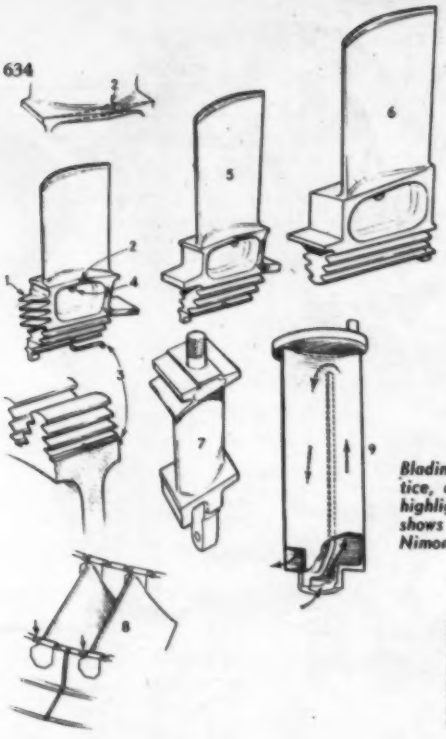
The diagram below indicates the flows of cooling air throughout the turbine section. Bleed air is passed around the bearings and over the rotor discs and blade roots and stator blades. The compressor-turbine and power-turbine balance pistons are also shown.

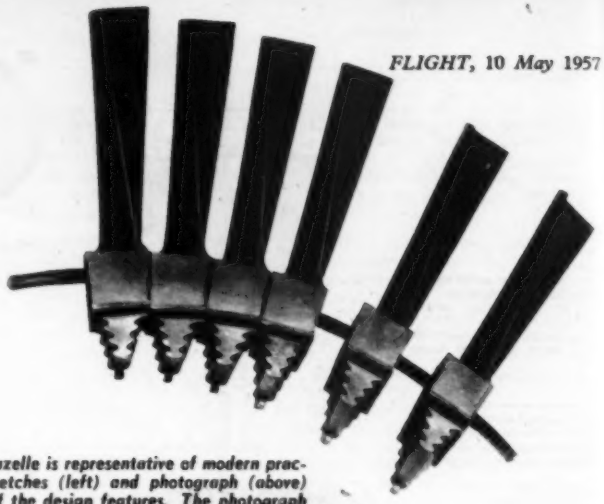


1 Air intake casing.
2 Variable-incidence inlet guide vanes.
3 Eleven-stage axial compressor.
4 Four support pads (no torque reaction).
5 Torque ring (to aircraft structure).
6 Compressor front and rear bearings.
7 Compressor-to-turbine shaft interconnection.
8 Two-stage compressor-turbine.
9 Compressor-turbine bearing.
10 Single-stage power-turbine.
11 Power-turbine bearing.
12 Power-turbine support flange and spider.
13 Power-turbine shaft.
14 Epicyclic reduction gear.
15 Vane-type torquemeter.
16 Output shaft to rotor system.
17 Diffuser casing.
18 Six inter-connected combustion chambers (upstream burners).
19 Turbine inlet casing.
20 Quadrupled jet-pipes.
21 Heat-shield.
22 Sixth-stage bleed-air gallery (compressor-turbine cooling).
23 Starter.
24 Gear train (starting, and drive to auxiliaries).
25 Pressure and scavenge oil-pump group.
26 Oil-cooler fan.
27 Centrifugal breather.
28 Inter-stage seals carried by expansion links off nozzle blades.



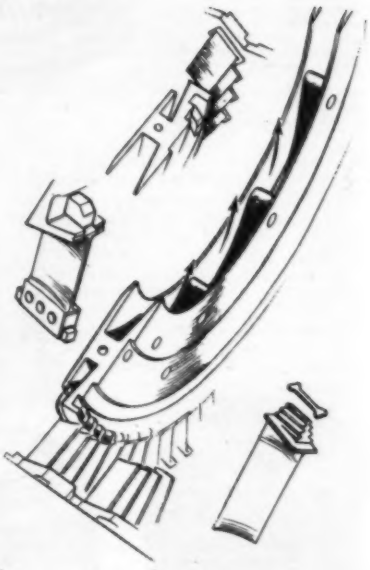
The illustrations above depict a typical helicopter Gazelle of NGa.1 rating with the following leading particulars: height, 70in; intake casing diameter, 33½in; dry weight, 780 lb. I.S.A. performance: sea level (2½ min emergency) 1,260 s.h.p. at 20,400 compressor r.p.m. with s.f.c. of 0.708; (1 hr) 1,100 s.h.p. at 19,800 r.p.m. with s.f.c. of 0.73; (continuous) 920 s.h.p. at 19,000 r.p.m. with s.f.c. of 0.773; at 6,000ft (continuous) 795 s.h.p. at 19,000 r.p.m. with s.f.c. of 0.75.





Blading in the Gazelle is representative of modern practice, and the sketches (left) and photograph (above) highlight some of the design features. The photograph shows how the turbine rotor blades are threaded on to Nimonic wire, which consists of two D-section halves.

1 First-stage compressor turbine: seal on front face excludes hot air, extracts cooling air.
2 Cranked face to avoid "bumps."
3 Nimonic locking wire.
4 Nimonic wire holes.
5 Second-stage compressor turbine.
6 Power turbine.
7 Typical turbine stator-blade.
8 Nozzle guides locked by peening.
9 V.I. inlet guide-vanes (separating wire equally divides volume, cooling air path shown).



Air is bled in from the tenth (final) compressor stage. The diagram illustrates the anti-swirl vanes which destroy free-vortex flow and prevent acceleration to sonic speed. The compressor blading (rotor, lower right; stator, left) is also shown; the top detail shows that one blade on each side is unsupported at its inner end at the axial casing-split.

NAPIER GAZELLE . . .

cast in Crown Max and touching the cool outer casing only at three small lands; a single attachment bolt is provided for each segment. The design has been evolved in such a manner that, with the appropriate cooling flow within the outer casing, tip clearance can be reduced to a minimum when the engine is running.

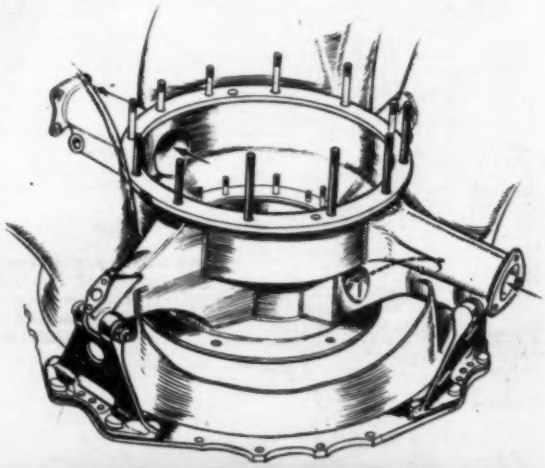
Operating pressure of the oil system is 80 lb/sq in. In addition to the metered feed to the main bearings already mentioned a controlled supply of oil is also fed to sparge-type jets on the one-piece planet carrier of the reduction gear and to the main reduction-gear bearings and the coupling splines on the outlet shaft. Engine oil is also the working fluid of the torquemeter and is supplied for that purpose by a separate high-pressure pump. In Gazelles intended for rotary-wing application the Serck drum-type oil cooler is cooled by forced-draught air from a centrifugal fan produced by the Airscrew Co. and Jicwood, Ltd. The oil cooling is effective even in extended hovering under tropical conditions.

Except for the fuel-metering unit, all accessories are mounted vertically on the upper face of the intake casting. All drives are made through straight spur gears off the lower end of the compressor shaft, the drive passing through one of the spats in the intake casting and leading to a train of 13 gears on the upper side. An electric starter has been fitted to most Gazelles so far built, but the gearing is stressed for combustion starters and a B.T.H. iso-propyl nitrate starter will be fitted to most of the Navy's engines.

Much research preceded the evolution of the Gazelle control system. Although essentially similar to that of earlier Napier engines, it incorporates a number of unusual features commensurate with the rotary-wing applications of the engine. Fuel is supplied by a Lucas variable-stroke pump which feeds any normal gas-turbine fuel—including D.E.R.D. 2482 (kerosine), 2486 (JP-4 wide-cut) or 2488 (JP-5)—to a Napier fuel-metering unit mounted on the main support plate. Top temperature is sensed by a mercury vapour unit and an r.p.m.-sensitive control governs the inlet guide-vanes to allow appropriate responses to changing power requirements. Any over-speed of the power turbine, such as might be caused by incorrect rotor setting or failure of the transmission, is accompanied by a sharp reduction in torque-

The item on the left is the planet carrier used in the reduction gear. It is worthy of special portrayal, since it is machined from a single steel forging. Each planet is carried in roller bearings.

On the right is the power-turbine bearing support, fabricated by precision welding. The reduction gearbox is mounted on the top, and the exhaust trunks are carried between the arms of the spider assembly. Arrows depict the flow of sixth-stage filtered air through the spider arms to the turbine bearing (dotted arrow) and oil scavenge (full arrow).



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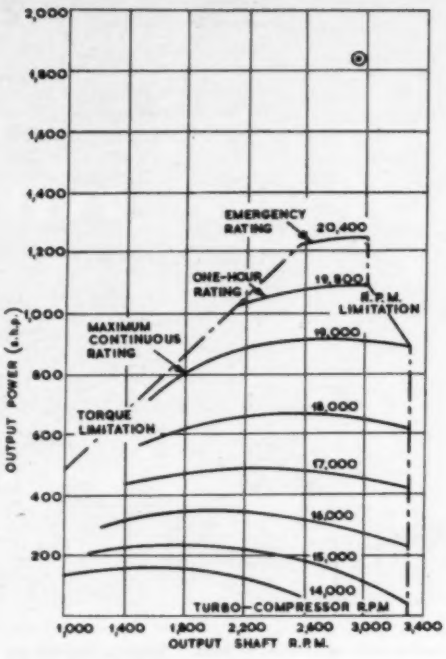
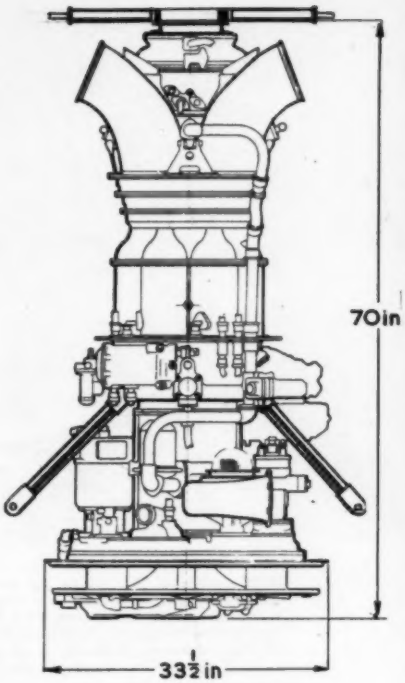
meter pressure below a pre-selected level at which the fuel-metering unit shuts down the engine. Overloading of the transmission is guarded against by a maximum-torque limitation. In the Bristol helicopters, failure, or undue power-loss, on either engine automatically produces a corresponding increase in fuel flow to the good engine, so that transfer to single-engine operation is automatic.

As already noted, the basic engine was designed for the Bristol 192, in which a Gazelle is mounted only 7 deg from the vertical directly beneath each rotor hub. The Gazelles for this aircraft are supplied as complete engine-change units, of the NGa.2 rating with an emergency power of 1,650 s.h.p. As in all tandem-rotor helicopters, both rotors are mechanically coupled together so that both can be driven by either powerplant. In such a condition a dead engine would be left at rest since a free-wheel is fitted in the final drive.

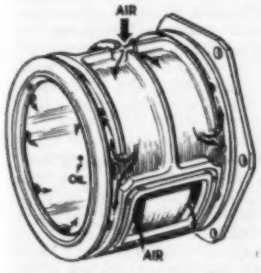
When the design of the Gazelle was well advanced, the engine was selected as the powerplant of the Westland Wessex, an Anglicized version of the Sikorsky S-58 which has been adopted as a standard Fleet Air Arm anti-submarine aircraft. Substitution of the Gazelle for the R-1820 piston engine of the American helicopter makes the Wessex faster, smoother and quieter, gives it improved performance and load-carrying ability, and should reduce fire risk.





Performance curves for the initial NGa.1 rating; the power of 1,830 s.h.p. has already been obtained during development. The diagram (right) shows mounting and torque-reaction for a Wessex powerplant.

In the Wessex the Gazelle is installed at an angle of 35 deg from the horizontal. In a conversion of this nature the aircraft manufacturer is naturally anxious to retain as much as possible of the fully developed basic airframe, and Westland wanted to adhere to Sikorsky's transmission, gearbox and rotor. The direction of rotation required was opposite to that specified for the Bristol helicopter and Napier's solution may be unique in aero-engine design: exit swirl from the compressor turbine was sufficiently low for a new power turbine to be designed with blades the "mirror image" of those previously specified. By this means the design change of rotation was made in less than a week.



This detail illustrates the flows of air and oil into, and out of, the housing for the compressor-delivery ball bearing in the main support plate. Oil is supplied through static-head valves.

Gazelles for the Westland helicopter also differ from their predecessors in a number of respects at the output end. In the Bristol 192 engine the output shaft is attached to the aircraft transmission by a muff coupling, but the Wessex drive is taken through a bolted flange. Torque reaction in the Gazelle is taken out at the drive end, and not transmitted through the carcase of the engine to the main mounting points. Engines for Bristol helicopters incorporate a toothed reaction coupling attached to the casing, but the Westland engine is provided with a torque-reaction beam bolted to the upper end of the reduction gearbox which transmits torque to lateral trunnions in a sub-structure pivoted to the airframe (see sketch at upper right).

As the Wessex has but a single Gazelle, the emergency 2½-min rating is not a requirement. The NGa.13 for the Wessex therefore has a 1,450 h.p. rating on a one-hour basis and a maximum continuous rating of 1,200 h.p. Owing to the flat performance curves (i.e., power on the output shaft varies very little with r.p.m. over the major part of the operating range) the power turbine in the Wessex engine is allowed to underspeed to match the characteristics of the Sikorsky rotor. The maximum rotational speed for the Wessex power turbine is 15,000 r.p.m. which is 2,000 to 3,000 less than for the Bristol engine.

Although the Wessex application was chronologically later than the original Bristol requirement, the Wessex is likely to reach the Navy slightly sooner than the completely new Bristol 192 will be delivered to the R.A.F. Wessex airframes are already in the preliminary stages of production at Yeovil and the Gazelle is going into production at Napier's main production works at Netherton, Liverpool. The finalized Wessex will have a neatly installed Gazelle engine-change unit, which is already finalized.

In order to prove the basis of the installation Westland Aircraft have installed a bare Gazelle in a Sikorsky-built S-58, and ground-running trials began with this aircraft in March. Westland's test pilots have already been greatly impressed by the smoothness and controlled power which the Gazelle offers. It is worth noting that excellent engine control is already being achieved even with the existing throttle cams designed for the piston engine, and the quietness of the Gazelle is emphasized by the fact that one can stand on an entrance step of the aircraft and converse with the pilot even with the engine running at high power.

In the same month, the Gazelle completed its 25-hr special category test (the test is really of 24 hours' duration, since it comprises four six-hour cycles) and should be put through its full Ministry of Supply type-tests as the Wessex powerplant by the end of the year.

It is also evident that in the Gazelle Napier have the basis of what could be a very attractive engine for fixed-wing aircraft. The fact that the drive comes out of the hot end of the engine should be no embarrassment to such applications and, in fact, a number of installations have already been investigated.

CHANGES IN ALUMINIUM, LTD.

DIRECTORIAL changes within the Aluminium, Ltd., organization have been announced. Mr. Fraser W. Bruce, managing director of the Northern Aluminium Co., Ltd., has been appointed president of the Aluminum Co. of Canada, Ltd., principal subsidiary of Aluminium, Ltd. He succeeds Mr. R. E. Powell, who has been re-elected a director of both Aluminium, Ltd., and the Aluminum Co. of Canada, Ltd., and will remain active in the management as a senior vice-president of Aluminium, Ltd. Mr. M. P. Weigel succeeds Mr. Powell as director of operations of Aluminium, Ltd.

Field Marshal Earl Alexander of Tunis, a director of Aluminium, Ltd., has been additionally elected a director and chairman of the Northern Aluminium Co., Ltd.; and Mr. S. E. Clotworthy, at present sales director, has been appointed managing director of the Northern Aluminium Co., Ltd., succeeding Mr. Bruce, who returns to Canada.

HELICOPTERS OVER PAKISTAN

Patrolling a Gas Pipeline

By CAPTAIN R. BRADBURY

HQ 1, one of the booster stations on the 350-mile pipeline which brings natural gas from Sui to Karachi. The Hiller 360 maintains constant vigilance along the line.

THE author of this article has had considerable experience of both helicopter flying and crop spraying; he began the former during his war-time R.A.F. service and after demobilization spent eight years in agricultural aviation in the United States. Now one of the senior pilots of Fison-Airwork, Ltd., he is at present engaged on their banana-spraying contract in Jamaica.

RECENTLY a team of archæologists unearthed Mahenja Daro—a town in West Pakistan built around 3000 B.C. and steeped in the mystery of an ancient world where once the sabre-toothed tiger lorded it over an impenetrable tropical jungle.

Five thousand years has worked immeasurable changes in West Pakistan. The encroachment of the Sind desert has buried those immense forests under a scorching plateau of sand. Man, too, has changed; it is hard to believe that the natives of today are descended from the men who built the mosques at Lahore and the Taj Mahal and equipped Mahenja Daro, 3000 years before Christ, with adequate drainage, irrigation and cooling facilities.

They are less inventive now, more resigned. In this ancient land, two years ago, a Fison-Airwork helicopter landed and the wind from its rotor blew the roof off an old man's straw house. When the dust settled and he could see again, he gathered the tattered matting together and carefully put the roof back. Then the helicopter took off, and once more the pieces of matting were strewn across the rice paddy. One day the helicopter made three visits and the old man re-made his roof six times. He did not complain; but he did see that the whirring blades were a danger to the villagers who ran eager and excited to the scene. He also saw how futile were the efforts of the pilot to keep the people away. So, armed with an immense stick, he became a self-appointed helicopter *choukedar* (guard). This new machine might destroy his roof, but it could also provide him with an unique job. One day he was taken up in it, so that later that night, over the charcoals, he was a man of importance able to recount how it was to have a bird's-eye view of one's roofless living-room.

The little straw house is no longer there, but the old man is. A small repeater station for the Sui-Karachi natural-gas pipeline was erected, and the house had to make room for a small heliport. The old man was made official station *choukedar* and lives in a small company bungalow with a concrete roof, handsomely finished in white.

Numerous similar local tales and anecdotes coloured the building of the 350-mile Sui-Karachi pipeline. Now it is finished and buried beneath the ground and the gas is being pumped smoothly down it; and just as the work of running it never ends, so the stories have become part of the local folklore.

The search for oil had brought the Burmah Oil Company to Pakistan some years before. Beginning their drilling at Sui, 350 miles north east of Karachi, in the hills above the upper Sind frontier, they found that the oil had gone, but that it had left a legacy in the subterranean vaults over 10,000ft below the surface —gas. It is hard to estimate how much gas there is there; but it is believed that if all the power-driven industrial plants of West Pakistan were converted to Sui gas, there would be enough to last for at least a hundred years.

The Sui-Gas Transmission Company was set up, a purification plant erected at the source, and a pipeline laid connecting it with Karachi and all the intermediary towns remarkably quickly. The first slug of gas emerged in Karachi in September 1955; within a few months the line was fully operational and consumers began to convert from oil to gas. Problems had now to be overcome in running the line and protecting it across the desert, swampland and heavily irrigated rice areas. Keeping it under observation presented the serious problem of easy access to the whole long route, for the engineers had to be able to get quickly to any spot, in order to make an adjustment, effect a repair, or just have a good look. Sui-Gas decided there was only one vehicle capable of doing this in all seasons—the helicopter. Accordingly they called upon Fison-Airwork of Bourn, England; and for almost two years one of their Hiller 360s has steadily been patrolling the line.

Along the route from Sui to Karachi are regulating and radio booster stations and at these the helicopter stops to check conditions, deliver mail or supplies and transport engineers on constant observation tours. Some of these stations are very lonely—remote bases of civilization in the desert, where vegetables and flowers are carefully nurtured beside the bungalows, and a few chickens and pets kept. There is always a cup of tea for the helicopter pilot.

The pipeline itself is largely buried about four feet below ground, except where it crosses the Indus or a large canal, when it is supported by a metal bridge or existing dam. It is sixteen inches in diameter and is usually loaded to about 800 lb/sq in pressure. The gas is highly combustible, being more than 90 per cent methane, so considerable vigilance must be maintained along the route and great care exercised when making repairs or adjustments. Pakistan is reputedly the hottest country in the world, and during the summer the thermometer soars to 135 degrees. Last year the cockpit canopy of the helicopter warped like a tulip leaf.

[*concluded at foot of page 639*

Seen from the Fison-Airwork Hiller: construction work in progress on a barrage across the Indus. The barrage will help to irrigate the surrounding countryside and will also serve to carry across the river the gas-pipeline extension now being laid between Sui and Multan, Pakistan.

COMPETITION GLIDING

Problems of Championship Task-setting

By ANN WELCH

WELL KNOWN in the British gliding movement, Mrs. Ann C. Welch, M.B.E., A.R.Ae.S., F.R.Met.S., has had extensive experience of the problems of championship soaring. She captained the British teams in the 1948, 1950, 1952 and 1956 world championships, and flew as co-pilot to her husband Lorne Welch in those of 1954. Vice-chairman of the British Gliding Association, Mrs. Welch is the author of a number of books on gliding. In this article she discusses the various factors involved in task-setting for championship meetings.

ONCE upon a time gliding championships were, by definition, a marathon for the pilot. Catapulted into the air after breakfast, he would spend the days flying with the wind as far as he possibly could, and the nights in being driven all the way back again. To see who could last longest at this sort of thing was clearly not the purpose of such competitions and it was realized that some modification to the rules must be made to keep abreast of the rapid development in pilot technique. Compulsory tasks are now set for every flight, many of which follow a fixed course and include a return to base. As a result the pilot's day now starts with a pleasant aero-tow to a couple of thousand feet, includes some hours of highly competitive soaring, and finishes, more often than not, with the pilot sleeping in his own bed.

The success or otherwise of such a championship is to a large extent dependent on the ability of those who set the tasks. It is not only a matter of choosing a flight which is reasonably possible on the forecast weather, but of obtaining desirable results from the contests; whereas in a world event the intention is obviously to extract the finest performances from the competitors, the aims in local championships may be to give training in speed or goal-flying, or just to provide as much general soaring as possible.

The first requirement of the task-setter, or his committee, is the services of a skilled meteorologist who has access to the latest met. reports. The relationship between the met. man and the task-setter must be good, and for the best results they should have some experience of working together well before any important championship, so that the morale factor of the met. man is fully understood. This is not to criticise his ability, but only to say it is necessary to know whether he tends to produce optimistic forecasts or gloomy ones in the early morning when the task-setting has to be done. An experienced met. man who understands gliding is extremely valuable, and if the championships are a success a great deal of the credit must go to him.

The task-setter needs a good contour map of at least one-million scale, preferably half-million, on which to visualize the scene. If this map can be fitted with a rule and protractor the task-setter's work will be simplified. He will be able to set a large number of tasks in a few minutes, reading off the flight time under the forecast conditions, and thus he can quickly discard any impossible ones.

"An experienced met. man who understands gliding is extremely valuable . . ." One such valuable man is C. E. Wallington, adviser to the British team at the 1956 world championships.

As soon as the task-setter knows what the weather for the day is likely to be he can begin to worry, for he must choose one of several tasks and decide in which direction the flight is to be made, and how long it should take. This seemingly simple problem is bedevilled by all manner of conflicting considerations and interests and a great deal of ingenuity may be needed to reach the best compromise.

Championship Tasks. In modern championships the tasks are all variations on a theme of distance and speed. There are neither tasks nor marks for duration or altitude.

(1) Free Distance. This task may seem a contradiction of all that has been said above, but free distance is a mandatory task for world championships, having to be set at least once. It is, as its name implies, a flight in which the pilot goes as far as possible in the direction in which he thinks he will get farthest. It is normally used in soaring conditions which provide opportunity for record flights. The rules may forbid the overflying of frontiers, in which case, should any pilot inadvertently go too far, only the distance to the frontier is counted for marks.

(2) Races. There are several different speed tasks. Those usually set for world championships are (a) race to a fixed goal, (b) out-and-return race, and (c) race round a triangular course of 100, 200 or 300 km. In national championships there is a greater variation in the choice of speed tasks. Such courses are short out-and-returns and triangles (in which the competitors are required to complete more than one lap) or dog-leg races (which have one or more turning points but do not return to the point of departure); in fact, any suitable course may be set which fits in with the limitations of the country and the needs of the competitors, provided that allowance is made for such flights in the rules.

As with most races, the winner is the person who achieves the greatest speed; but, owing to the nature of gliding, considerable skill may be needed merely to arrive. The race to a fixed goal is a proposition quite different from races having courses in more than one direction. In fixed-goal races there need be no limit, other than safety, to the wind strength, but in multi-direction races the wind must not be so strong that into-wind progress is impossible.

(3) Distance Along a Line Set by the Organizers is a useful task, as it can be used to control the direction of flight. This may be desirable owing to the existence of dangerous landing-country, control zones, or firing ranges. Further, by setting the line with a greater or lesser degree of into-wind component, flights of several hours' duration will be obtained over a limited ground-distance. The marking system usually penalizes, with increasing severity, divergence from the set line.

When the forecast is in doubt this task has an advantage over a fixed-goal race, as the line in theory is endless; if the weather is worse than forecast there is still a chance of the task being satisfactory, whereas if the weather is better than forecast the opportunity exists for a longer flight. *[Continued overleaf*

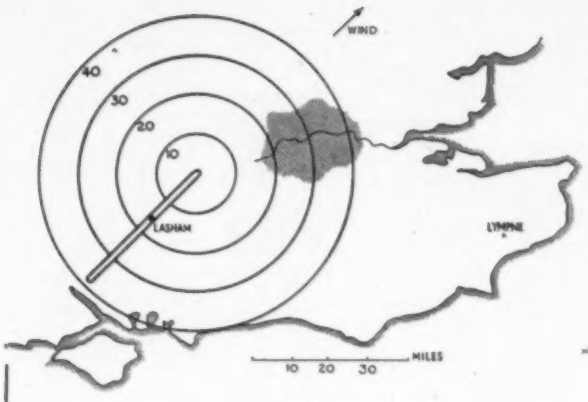


Fig. 1

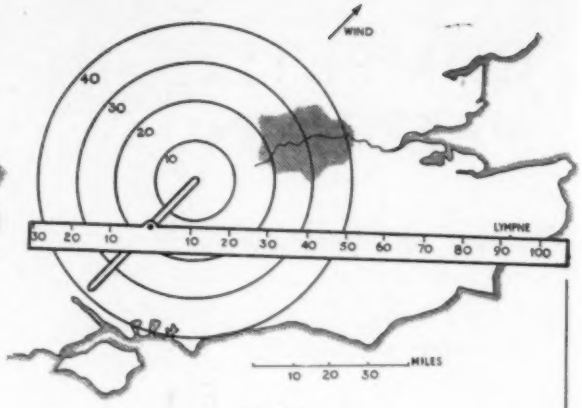


Fig. 2

This task-plotter, designed by Lorne Welch, consists in its simplest form of a mounted map and a transparent disc. The disc has a series of concentric circles to the same scale as the map; it also has a slot which slides over a peg located at the gliding site. In use the disc is placed in such a way that it shows the direction of the wind and its strength.

Fig. 1 shows the disc set for a S.W. wind of 16 m.p.h. (note that the wind is indicated in a downwind sense). The average air distance which a glider can make good in one hour can be assessed from the met. forecast of the thermal strengths. Let us say that it is 30 miles. On this particular day the 30 m.p.h. circle on the transparent disc will show the geographical positions which a glider could achieve after one hour's flying.

Fig 2. The addition of a rule pivoted on the gliding site and calibrated in miles permits the speedy assessment of the time taken for a number of different tasks. If the average airspeed is 30 m.p.h. the point at which the rule intersects the 30 m.p.h. circle in the direction of flight shows the groundspeed that will be obtained in this direction. The groundspeed which could be made good on a return flight can be read off on the other end of the rule. Swinging the rule will give the groundspeed for any direction of goal.

The illustration (Fig. 2) shows the rule set for an out-and-return flight Lasham-Lympne-Lasham giving a groundspeed of 38 m.p.h. on the way out and 17 m.p.h. for the return. Since the distance to Lympne is 93 miles, the time taken will therefore be 2.5 hr and 5.5 hr respectively, a total of 8 hr. It is improbable that thermal soaring will be practicable in England for more than about 6 hr, and such a flight is most unlikely to be achieved unless a higher airspeed can be maintained. If the thermals turn out to be better than was forecast, so that an average airspeed of 40 m.p.h. could be maintained, groundspeeds of 49 m.p.h. and 28 m.p.h. would be achieved on the two legs. These give 1.9 and 3.3 hr—totalling 5.2 hr, which is therefore possible. As the task can be set only on the forecast this flight would not be selected.

COMPETITION GLIDING . . .

Normally the set line is considered to be straight, but there is no reason why it should not be a dog-leg or even a reciprocal course. Should it be desirable to reduce the amount of retrieving, and at the same time avoid an endless succession of goal races, such an alternative is most useful.

(4) Pilot-declared Goal. A distance flight in which each pilot nominates his own landing place before taking off. It is no longer set in world championships, but is of much value in nationals: it forces pilots to make a comprehensive survey of how best to use the day's soaring, which is excellent training; and it throws the choice of task back at the pilots if the task-setter, in despair, cannot make up his mind what on earth to select.

The Choice of Task. Which of the above tasks is chosen, and its direction and extent, depends on a number of considerations. These include the weather, the skill of the pilots, the purpose of the competition, the performance of the gliders, the geography of the country, and an assortment of miscellaneous factors.

(A) The Weather. Provided that there is sufficient instability to make soaring practicable, the most important aspect of the weather is the strength of the wind. Unless the task-setter can get an accurate forecast of this, he will not be able to decide if flights (other than those with some down-wind component) are possible. The average airspeed of the glider, i.e., its point-to-point speed in still air, depends on the strength of the up-currents which the pilot can find, and to some extent on their shape and distribution. Under really exceptional conditions average airspeeds of 50 kt or more have been obtained, but in England 30 kt is good, and most cross-countries are done in the range 15-20 kt. Under these conditions it is obviously hopeless to have a task involving a headwind component of 20 kt. In winds of this strength the groundspeed will be so low that any mistake in technique will result in ground being actually lost.

A further consideration when setting an into-wind task is that of the characteristics of the approaching air mass. For instance, the lift-killing properties of a warm front extend far in advance of its bad weather and, whereas a downwind task could keep the competitors sufficiently far in advance of the front to be unaffected, tasks set towards the weakening lift will result only in an unrewarding struggle.

The wind direction, and any imminent changes, next need to be known with some accuracy. In few countries are there likely to be a profusion of aerodromes or known large fields which can be used as goals when setting a race. Frequently the choice of a goal is a compromise between reasonable ground-mileage and acceptable cross-wind component, so that a flight of a suitable duration is selected as the task. Should the forecast be wrong, or wind changes not anticipated, the task may become impossible if a greater headwind component develops, or too easy with a tailwind.

Next in importance after wind-strength and direction are the strength and distribution of thermals. The task-setter wants to know whether the thermal distribution is likely to remain uniform, or whether the cumulus will (a) flatten out periodically during the day, (b) develop into widely spaced masses of cumulo-nimbus, (c) be affected by high cloud, or (d) not appear at all, the thermals being "dry".

Most days of ordinary summer cumulus have either two or four flat periods, due to some over-production and flattening-out of cloud, and this is to be expected. If these periods are likely to be severe enough to kill the lift intermittently, it is important that they be forecast. Any development from small cumulus to widely spaced masses of cumulo-nimbus should also be known, particularly if a short race is contemplated, as the existence of a single huge cloud on or near the track introduces too large an element of luck. This cloud will probably be the only source of lift within reach, and so such things as the time of launch of any given competitor, or too much or too little conscience about entering cloud immediately after another glider, assume undue importance.

For effective into-wind flying the lift distribution needs to be fairly uniform. Patchy or infrequent thermal areas will be more of a disadvantage than when the glider is travelling with the wind and is able to stay in the good areas while the wind drifts it on its way.

There are two other aspects of the weather, both local, which can seriously upset the task-setter's reputation if they are not foreseen—a sea breeze, and industrial-haze streams. On days of strong convection the sea breeze may penetrate inland some 30-40 miles by late afternoon, and little if any lift may be found in the areas affected by it. The encroachment of the sea breeze throughout the day may well be a more important factor in determining the direction in which a triangular course should be flown than may any possible shift in the main wind.

Little need be said about industrial-haze streams. Gliders should not be sent through them if this can be avoided. The haze not only cuts off the lift, but may reduce visibility to a dangerous extent.

(B) Skill of the Pilots and Purpose of the Competition. The latter consideration will affect the choice of task depending whether or not the competition is intended to achieve some specialized object. It is, however, a minor point compared with the problem of setting satisfactory tasks for the usual wide range

of pilot skills to be found in most championships, and particularly in nationals.

In gliding the skill of the pilot remains, in general, more important than the performance of the glider. High-performance gliders flown by indifferent pilots would have to be set easier tasks than good soaring pilots flying those of medium performance. In nationals, with the skill of the pilots ranging from that of world-beaters to the tyro having his first bash, task-setting is difficult. If the flight is to be a challenge to the top pilots, it will be quite impossible for "the tail".

The contest rules usually require that a certain number of competitors must achieve a known minimum performance on each day, otherwise nobody receives any marks. This is a wise precaution; but, in fact, the task-setter must aim for a much higher proportion of gliders to reach the goal in races so that their speeds —and not merely the pilots' ability to get there—can be compared. The course set should be such that, even if the weather is worse than expected, it is still reasonably capable of completion by a good proportion of the contestants.

The effects of pilot fatigue should not be forgotten. These effects become serious during a long championship if the flying has been exacting. If necessary, easier tasks should be given or a rest day declared.

(C) Performance of the Gliders. Tasks should not be set which are beyond the performance of the glider, i.e., a sailplane of poor penetration should not be given a flight against the wind when this is too strong for the machine to make headway. Exceptions may have to be made if one or two low-performance gliders have been entered in a competition just for the hell of it, in order that the task will be worthy of the bulk of competitors. Only windward races are likely to be physically impossible; distance flights (and even downwind races) do not penalize the glider in the same way.

(D) Geography. Apart from any effect it may have on the local weather, the main consideration is safety in landing. Large forested or built-up areas should be avoided. Hilly or mountainous regions, on the other hand, may have no disadvantage provided that there are some fields in the main valleys. Normally the slope of the lateral valleys towards the main valleys is greater than the gliding angle, so that as long as these valleys have landing places there is no undue risk.

Other areas to be avoided are large damp or marshy regions, while those known to be particularly good for thermals should, of course, be used.

Turning points, other than aerodromes, should be chosen so that they are easily visible from the air, and have possible landing-places within a mile. High ground does not stand out well, and a hill should not be selected unless it is made unmistakably prominent by a monument, building or other feature. Viaducts and junctions of main railways with canals or rivers are good. Lakes or woods of odd shapes can be used as pointers for turning points of only moderate prominence, but are not satisfactory in themselves.

(E) Miscellaneous. The rules, with particular reference to the marking system, and the arrangements for launching the gliders, will need to be studied. For instance, the take-offs may be made at a fixed time and in a pre-arranged order, or the pilot may be allowed to select his own take-off time. In the former case the task-setter will also have to declare this time. If he makes it too early there may be an unnecessary number of wasted launches; if too late, good soaring weather will be lost.

Tasks must be set so that infringement of the Air Navigation Regulations is not encouraged, and so that pilots are unlikely to be shot at by over-enthusiastic gunners.

The state of the roads (particularly near coasts at holiday time) becomes a serious factor. Deliberately putting forty 30-ft trailers on to inadequate or congested roads is not to be undertaken lightly; the degree of frustration and nervous exhaustion suffered by competitors and general public alike may be appreciable.

There must be the utmost determination to avoid setting tasks on a basis of publicity or spectacle, for task-setting is quite hard enough when attempted with due regard for the important aspects. Such things as local fêtes, early-closing days or civic ceremonies should not be allowed to enter into the matter.

Finally, there is the problem of time. In order that soaring weather is not wasted, the task must normally be set by about 9.30 a.m. (under English conditions). This means that the weather assessment and the selection of task must be dealt with well in advance of this time, since it may be necessary to obtain permission from the operators of aerodromes selected as goals, or to arrange for turning-point observers and get them on their way.

* * *

Task-flying in championships is here to stay, and the more people who can become skilled at setting tasks the better. Too little is known about this important aspect of gliding competitions, and as a result contests may easily be ruined by ill-chosen tasks.

Also in the hands of the task-setters, particularly in world championships, is a tool—or even a weapon—to fashion the development of gliders and of soaring technique. For example, championships which are little else than short-course pylon races, for the benefit of spectators who pay entrance-money, will encourage gliders and pilots who are good at this sort of thing, and we may lose sight of the real purpose of soaring—that of exploring the air and learning more about its power and character. The Gliding Commission of the F.A.I. keeps a jealous and competent eye on the rules and regulations, but even within the existing framework pure spectator-flying could be encouraged to a large extent by a determined organizer.

The World Championships in France last year demonstrated the benefits of courageous and far-sighted task-setting. As a result there now exists a wealth of experience and knowledge about the big wave-system that exists in the Rhône Valley, opening up the possibility of 500-mile distance flights in Western Europe. These explorations showed what really can be done with gliders when flown by first-class pilots under competition conditions.

HELICOPTERS OVER PAKISTAN (continued from page 636)

Flying along the route on patrol is interesting work and not without incident. One's normal height is about fifty feet or less and the speed about 60 m.p.h. so one can see everything from a leak to a lizard. Sometimes a daring soul in a group may throw a stone at the aircraft. The procedure then is either to turn around smartly, land and berate the culprit, or to bring the helicopter in low and chase him up a thorn tree. In either case the surprise value of the counter-action is most effective. But for the most part people who live along the route want to be helpful, and it is only understandable that when the helicopter lands near them they rush to see and touch it. Once approaching a very arid area in the Sind desert where I was inspecting part of the line there appeared to be nothing within miles but wind, sand and sun. The inspection took about five minutes, but by the end of it I had an audience of some thirty Bugti tribesmen.

During the monsoon season, which lasts only about two weeks, severe flooding along the Indus nevertheless does a great deal of damage and costs many lives. The helicopter is often called upon to fly mercy missions with plasma, medicines and supplies, and the people's attitude of utter resignation to this yearly catastrophe was a constant source of amazement to me. Most pitiful was the state of the animals, often left to fend for themselves as the waters slowly rose and, engulfing them in a final swirl, offered another carcase to the waiting vultures.

Animals react to the helicopter in many different ways: chickens, for example, always go beserk in a frenzy of feathers and dust. Goats and sheep move off in an excited rabble, diligently keeping their tails towards the noise. Gathering momentum, they describe a great arc so that, when the helicopter is as far past them as it was when they first heard it, they are roughly back to their starting point. The local shepherds now no longer attempt to restrain their flocks but remain peaceably on their haunches until the animals reappear through the brush. Cattle and oxen merely become restless; the buffalo stares balefully into the air and paws the ground. Most creatures classify the helicopter as some gigantic hawk and, having estimated their chances, according to their weight, react accordingly. There is one exception. The camel—from whom man has never exacted complete submission—composedly defies intrusion with a derisive, inscrutable dignity.

Fison-Airwork's helicopters are gradually becoming accepted in Pakistan, not just as an indispensable part of the Sui-Gas equipment, but as an answer to problems centuries old. Such a machine is an immense asset in developing a land which, though rich in minerals and other potentials, has heretofore been hampered by difficulties of communication and survey. Certainly the Sui-Gas Company have found it so. Currently a new line is being laid north from Sui to Multan in the Punjab, and the machine has been of immense value in carrying out advance survey work over difficult terrain as well as in ferrying engineers across the Indus and to and from the "spread camp". In primitive areas like this hundreds of people die each year because of flooding, malaria and other diseases which must be located, controlled and constantly checked. In such areas the helicopter is often the only way of saving lives—and certainly the only quick way of gaining access to distressed people.

Patrolling the Sui-Gas pipeline is the first full-time job helicopters have done in West Pakistan. But now that Pakistan is an independent nation, its government is determined that it should become an increasingly significant force in the world. Obviously the helicopter as well as the fixed-wing aircraft has a valuable part to play in achieving this aim.

THE INDUSTRY

Napier-PacAero Agreement

UNDER a recent ten-year agreement, PacAero Inc., of Santa Monica, California, have acquired the right to manufacture and sell the Napier Spraymat electrical system of de-icing in the United States.

Napier are to supply the drawings, reports, technical information and assistance needed to enable PacAero to establish manufacturing and servicing facilities, while for their part the American company will make available to Napier details of refinements and improvements which may result from development processes applied to the system.

Glass-Plastic Airliner Seat

A GLASS-REINFORCED polyester plastic has been used—for the first time, it is believed—to form the complete basic structure of an airline seat. Microcell, Ltd., have produced the prototype of a two-place seat for high-density layouts which, for a total weight of 42 lb, has a basic structure-weight of a little under 18½ lb. This compares with weights of 60 lb and 33 lb for conventional equivalent seats.

The main structure of the new Microcell seat is made up of glass reinforced plastic mouldings bonded together and, in places, riveted for additional security. Designed under M.o.S. sponsorship, the seat has passed tests for forward-facing installation and is stated to have shown good energy absorption characteristics, having successfully withstood 10.8g forward load.

Prototype Microcell seating.

Additional advantages claimed for the Microcell seat include ease of production, fewer parts of the basic structure, a weight saving of 10 to 15 per cent over previous structures, and lower production costs. It is hoped to test the new seat operationally in the near future. Microcell, Ltd., 56 Kingsway, London, W.C.2, are the makers.

Shorts' Apprentice Prizegiving

WHEN the Short Brothers and Harland apprentices' prize-giving was held recently at Belfast the chairman, Rear Admiral Sir Matthew Slattery, extended a special welcome to Mr. C. P. T. Lipscomb, who had only recently relinquished his position as a director. His career, said Sir Matthew, was an outstanding example of the opportunity offered by apprenticeship in industry; after serving his at Woolwich Arsenal and working for a period at the Coventry ordnance factory, Mr. Lipscomb had joined Shorts in 1914 and (except for a period from 1916 to 1921 at the airship works, Bedford) had been with the company ever since.

Sir Matthew said he wished to stress two points which would have special impact on Shorts' arrangements for apprentice training. One was the Government's request to all employers in Northern Ireland to allow any boy between 16 and 18 to go to technical school on day-release if he wished to. This had in some cases resulted in these schools becoming overloaded. Facilities for taking the necessary courses for City and Guilds examinations were worsening and Shorts might have to consider making special arrangements to ensure that the 700 boys always in training with the company had adequate facilities for their technical education.

His second point was that if the school-leaving age were raised to 16, boys who came to the company would have to go straight into apprenticeship if they were to complete their training by 21. Shorts liked to have them for six months before apprenticeship, to judge their aptitude, and would try to find a solution to this problem. One answer would be to extend apprenticeship to the age of 21½; another, by national agreement to reduce its period from five to four-and-a-half years; a third, for Shorts' training scheme to be recognized as the equivalent of a technical school, so that boys could come to the company at 15½ instead of 16.

Mr. Lipscomb in his address said that an apprentice today had "unlimited opportunity" in whatever branch of engineering he chose to follow. The growth of interest in science and mathematics among grammar school boys was an encouraging sign, and the increasing complexity of aircraft design had created new demands for highly skilled personnel. He did not see any grounds for fear in the advent of guided missiles since any modern aircraft company was adequately equipped to manufacture either piloted aircraft or missiles and, for many years to come, the latter would probably only replace fighter and intercepter types and (at a later date) heavy bombers.

In his report on progress during 1956 the apprentice supervisor, Mr. F. C. Kirkpatrick, said that 79 apprentices had qualified for indentures; the total number (not including those apprentices attending the University for full-time studies) of those attending day-release and evening classes was 533; the intake of apprentices was 165 and at the end of 1956, 2,000 applications had been received for this number of vacancies.

Prizes were presented by Mrs. Lipscomb, and among the winners W. T. Anderson gained a special award as the best all-round third-year apprentice.

Simmonds Aerocessories Changes

ADDITIONS to their Board, and the formation of a new subsidiary company, were recently announced by Simmonds Aerocessories, Ltd. Mr. G. E. Bache becomes executive director and general manager and the following have been appointed executive directors: Messrs. S. H. Goss (general sales manager); C. J. Williams (works manager); P. Pehrson (export sales manager); A. Beard (production adviser and methods engineer) and J. Burnell (chief mechanical engineer).

The new subsidiary, Firth Cleveland Instruments, Ltd., at Treforest, Glam., adjoining the existing Simmonds factory, is to manufacture and market instruments formerly produced by Simmonds Aerocessories and will also take over from the parent company developments in instrumentation for aircraft and other applications. Mr. C. W. Hayward is chairman, and the following have been appointed members of the Board: Messrs. L. G. Oxford and E. S. Mead (joint managing directors); F. R. Allen (executive director and general manager); and S. H. Goss, P. Pehrson and D. Broadbent (executive directors).

IN BRIEF

A contract has been placed with the spray packaging division of R. A. Brand and Co., Ltd., for the supply of a large number of Texikoon re-usable plastic covers to the R.A.A.F.

* * *

Mr. Derek J. Upcott has been appointed Far East technical representative of D. Napier and Son, Ltd., and was due to leave for Singapore by air on May 7.

* * *

Mr. J. Cuthbert Robinson, chairman of Thomas Robinson and Son, Ltd., Rochdale, has been elected president of the Machine Tool Trades Association for 1957-58, in succession to Mr. H. P Potts.

* * *

Relinquishing his appointment as public relations officer to Vickers-Armstrongs (Aircraft), Ltd., Mr. John Gunn is returning to his native Australia, where he has formed his own firm of public relations consultants, John Gunn Associates, in Sydney.

* * *

Spitfire Mitchell Memorial Fund Scholarships have been awarded by the University of Southampton for 1957 to David Richard Harris of Vickers-Armstrongs (Aircraft), Ltd., Weybridge, and David John Martin Williams of Vickers-Armstrongs (Aircraft), Ltd., Hursley Park.

* * *

The annual accounts of Titanine, Ltd., show a post-war record for the business, with a net profit of £39,109 after full provision for taxation. The chairman, Admiral Sir Lionel Preston, reports that the demand for their aircraft finishes increased during the year, "especially in the direction of internal protective schemes for passenger aircraft." His statement also refers to negotiations, now nearing completion, for a new site for a synthetic-resins factory at Welwyn Garden City.

IN THE DOCK

Facilitating Airliner Maintenance

FOR many years it has been customary to talk of ships in dry dock, and for even longer of human beings in dock of another kind, both for examination; but only since the war has the idea of putting aircraft in docks for maintenance checks come to be an accepted idea in this country. The first was built for B.E.A. Dakotas in 1948; in 1953 one was constructed for the Corporation's Elizabethans; in the following year Viscounts were "fitted"; a second Viscount dock, adjustable to take either the 700 or 800 series, has been completed this year; and now the Britannia has gone into B.O.A.C. service with similar facilities.

Acceptance by B.O.A.C. of the idea of such a dock, and its coincidence in service with the aircraft for which it was designed, puts a final seal of success on the design and construction work done in this field since 1948. What may then have appeared revolutionary has now become an integral part of maintenance schedules; and in reducing turn-round times the docks are helping to increase utilization. Construction of those for the Corporations has been carried out variously by W. and A. Williamson and Co., Ltd., in the case of the Check IV Dakota dock; the Heston Aircraft Co., Ltd. (the Elizabethan); B.E.A. (the Viscount—employing direct labour); and six contractors jointly on the Britannia dock. Rodger, Setterington and Partners, of Western Avenue, London, W.5, have been design consultants on all the docks here described.

To visit the B.E.A. and B.O.A.C. engineering bases at L.A.P. is to get an instructive bird's-eye view of the different types of maintenance dock, for in those well-lit and well-warmed edifices are Pionair/Leopards, Elizabethans, Viscounts and Britannias all snugly tucked away, with engineers carrying out their checks in conditions of comfort and accessibility.

In basic principle the docks do not vary from the earliest to the latest: they provide a permanent working platform in place of improvised ladders and trestles; as they are built to fit the aircraft, the risk of damage involved in moving loose equipment or temporary working platforms is practically eliminated; and electrical and other services can be brought efficiently and neatly to hand.

The variations which occur (apart from those necessarily involved by the shape of the aircraft for which each dock is designed) are in simplification of construction; use of high-level platforms to give access to the top of the fuselage; introduction of an intercom system; and (in the Britannia dock) the provision of wheel-pits.

When the first dock was constructed it was intended to be of a temporary nature, for at the time Dakotas were thought to have only two more years' service; thus the main structure was formed of scaffolding connected by patent clamps, and this gave the appearance of a forest of columns. Since then the main structure has been built of conventional mild-steel rolled sections, with the result that it has a much neater and less complicated appearance.

The greater height of the more recent aircraft for which docks have been designed has made it necessary to have a high-level platform, giving access not only to the tail unit but also to the top of the fuselage along its whole length. (This platform was first introduced with the Viscount; naturally nosewheel-undercarriage low-wing aircraft have a greater overall height than those with tailwheels or high-wing layouts.) In the case of the Britannia (the tail fin of which reaches up to 39ft), it has been necessary to have an overhead structure partly supported from the hangar roof.

Introduction of wheel-pits, so that undercarriage retraction tests can be carried out, is a modification peculiar to the Britannia dock, since the undercarriage bogie rotates through about 90 deg before retracting, and clearance had to be provided as an alternative to jacking up the whole aircraft by 3ft.

The Britannia dock has also been designed to accommodate the 100 and 300 versions of the aircraft, the latter being 10ft longer. Furthermore, a telephone system has been provided at the supervisory control point which can, if necessary, over-ride any local conversations. There are instruments at 12 different positions, each connected *via* a master indicator panel to the aircraft cockpit.

There is so much to be said in favour of maintenance docks that it is curious they did not appear on the scene earlier in aeronautical history—perhaps because aircraft maintenance was a much less complicated business than it is now; perhaps because war interrupted the progress of civil aviation. Only when an aircraft type is likely to be in service for many years is it worthwhile constructing for it a dock which may cost up to £25,000. Such an initial cost is high, but it should be recovered in two years on the saving in turn-round times.

Four types of maintenance dock, showing their progressive development since 1948. From top to bottom they are for the Dakota; Elizabethan; Viscount; and Britannia.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Stringfellow's Experiments

THE nostalgic contribution by J. M. Bruce on the Sopwith Triplane must bring back many memories of a very remarkable machine. His articles are written with such care and detail that I hesitate to challenge a part of his early history. In this it is stated that Stringfellow achieved success with a monoplane model of 10ft span in 1847: "The aircraft had a climbing angle of 1 in 7, and flew for some 40 yards before witnesses at Cremorne Gardens, London. There can be no doubt that, had a suitable power unit been available to Stringfellow, he would have antedated the Wright brothers' success by decades. His monoplane was the world's first successful heavier-than-air flying machine."

All the available evidence indicates that Stringfellow's model failed to make a successful flight at Cremorne. The evidence was given at considerable length in the first Henson and Stringfellow Lecture read before the Royal Aeronautical Society and published in the June 1956 issue of the *Journal*. Nor was Stringfellow's triplane model any more successful. The claims for Stringfellow have often been made, but the close examination of these claims, and contemporary letters in the possession of the Aeronautical Society, do not support them. Indeed, there is no doubt that Stringfellow had no more knowledge of model aircraft than that which he had picked up from Henson, and some trial-and-error experiments of his own afterwards. He knew nothing about controls and sacrificed all ideas of strength to get a light model into which to put his engines.

The claim that he might have antedated the Wrights is a flight of fancy. Stringfellow's ability was as a craftsman in the construction of small steam engines. He was indeed fortunate to have met the aircraft designer, William Henson, otherwise he would not have been known.

Brighton, Sussex. J. LAURENCE PRITCHARD.

Tactical Conundrum

THE new-model Army, it appears, is to consist of a small number of highly trained units, equipped with the latest weapons and kept, it is to be hoped, at full war strength, which are to be transported by air to any trouble spot.

Suppose the occasion arises to send two thousand such troops to quell a disturbance, and that they travel in twenty-five unarmed transports whose speed is 325 m.p.h. Is this fleet to go unescorted? If so, what happens if the enemy "borrows" from an ally a dozen conventional 550 m.p.h. fighters armed with conventional weapons and attacks it?

Richmond, Surrey. ANAX.

D.D.L.'s Condors

THE recent spate of correspondence on the Fw200B Condor OY-DAM (alias G-AGAY and DX.177) has certainly been most illuminating; especially Mr. Quin-Harkin's letter (April 12), wherein he mentions the funeral service of Captain Hansen having taken place on July 29, 1941. This date throws new light on the time of his accident with the Condor at White Waltham. Obviously the test flight could not have taken place in August, as Mr. Cheesman stated in his interesting book *Brief Glory*.

With this in mind, I started searching for evidence of the true date and was rewarded by the accident report clearly stating it to be July 12, 1941. This makes the time-lapse—from the Condor accident to Hansen's death—considerably shorter than Mr. Cheesman realized; less than 17 days, in fact.

I would be most interested to know more concerning the history of D.D.L.'s second Condor, OY-DEM, named *Jutlandia*. Unlike OY-DAM, this machine remained in Denmark during the occupation and made a surprise visit to Northolt in May 1946. I saw *Jutlandia* on several ocasions during 1946, until it was withdrawn from use and parked close to the west boundary of Northolt Airport. It languished there for some time and was slowly dismantled until, finally, the remains were broken up. D.D.L. also owned a third Condor, but I am not aware of its identity.

Ruislip, Middlesex. PETER W. MOSS.

A Club Moves Out

I AM very sorry to hear that the Bucks Flying Club at Denham is being forced to find another aerodrome from which to operate. I have been flying privately ever since I left the Service at the end of the war, and enjoy keeping my hand in very much indeed. The price has crept steadily up and up during that time, until it has now reached an exorbitant level. I still manage, though, to find the money somehow for a few flights every year.

I have belonged to many flying clubs in that time, but since 1954 I have been a member of the Bucks Club. I think it has the most informal and congenial atmosphere I have come across. I gather the reason behind the pressure on Mr. V. B. Nightscale, who runs the club, is that he is not "in the price ring"! He sells flying at 10s to £1—or more—cheaper per hour than most other clubs.

Flying clubs are constantly asking for private flying to be subsidized; they claim rising costs are crippling the sport. This no doubt is true, but here is a man who makes an effort to keep the price down and he is, in effect, penalized for it. The other clubs may say they cannot do it for less than they charge; but here is a man who is proving it can be done!

He obviously cannot afford to make a loss, nor can he be stealing much of the custom of other clubs: one small club like his with a handful of aircraft simply could not do that. The public is extremely air-conscious at the moment, and there must be many, many people who would like to fly, but cannot face the fantastic cost.

I sincerely hope some outside effort will be made to allow this club to stay where it is, or at least to help it to find another aerodrome within a reasonable distance (30 miles of central London).

London, W.1. DANIEL NICHOLAS.

Veteran Airliners

AT the risk of calling down the wrath of Mr. K. Tudor for supplying the "useless information" or "trivial comment" complained of in his letter in the April 26 issue of *Flight*, may I enlarge a little on the statement in my article ". . . Pronounced Vi-count" [in the same issue] that Capital Airlines still operate the second, third, fourth, fifth, sixth and ninth production Skymasters?

These aircraft were part of the first batch, with serial numbers 41-20137 to 41-20145 and constructor's numbers 3049 to 3057, which were completed as C-54-DO Skymasters for the U.S. Army Air Corps Troop Carrier Command in 1942. After the war the second, third, fourth, fifth, sixth and ninth entered service with Capital and became (respectively): N88839 *Capitaliner Cleveland;* N86554 *Capitaliner Washington;* N88745 *Capitaliner Charleston;* N88840 *Capitaliner Milwaukee;* N86555 *Capitaliner Cavalier;* and N88746 *Capitaliner Knoxville.*

All this information may seem trivial—even useless. But the fact that a leading American airline (by coincidence) operates both the oldest Constellation and what must surely be the oldest Skymaster in regular, scheduled service is both a tribute to the excellence and durability of these aircraft, and a reminder that the world is still short of transport aircraft. The latter is brought home not only when one reads of such incidents as the rebuilding of Dakota KN550 for Aden Airways [*Flight*, March 15], but also when one reads of aircraft such as *Capitaliner Cleveland* which are still in service, instead of in the Smithsonian or on the scrapheap.

This point is worth remembering at a time when the attitude of so many airlines towards re-equipment with big jets is (superficially, at least) that of the young lady in *Oklahoma* who sings: "I'm just a girl who cain't say no."

Rustington, Sussex. M. J. HARDY.

FORTHCOMING EVENTS

May	10.	Helicopter Association: "Military Helicopter Operations in Malaya," by W/C. W. R. Williams, O.B.E., D.F.C.
May	14.	R.Ae.S.: Section Lecture: "Reinforced Plastics for Primary Aircraft Structures," by W. A. Baker, Grad.R.Ae.S.
May	15.	R.Ae.S.: Graduates and Students Sections: "Guided Weapon Research and Development," by W. H. Stephens.
May.	17.	Institute of Navigation: "Navigation and the Airlines," by E. W. Pike.
May	18.	British Interplanetary Society: A.G.M. and Brains Trust.
May	18-20.	Quiberon Aero Club: Air Rally and International Touring Meeting, Quiberon.
May	21-23.	European Aircraft Ignition Conference (Champion Spark Plug Co.), London.
May 24-June	2.	Paris Aero Show, Le Bourget.
May	25.	Elstree Flying Club: At Home and Flying Display.
May	25-26.	Popular Flying Association: Annual General Meeting.
May	26.	Luton Flying Club: At Home and Flying Display.
May	28.	R.Ae.S.: Section Lecture: "Flight Instruments," by F. W. Meredith, F.R.Ae.S.
May. 31-June	1.	Aero Club of South Africa: Governor-General's Air Race.
June	1-2.	Aero Club of Western France: International Rally, Anjou.
June	5-7.	Institute of Navigation: "Avoidance of Collision by Shipborne and Airborne Means," a Three-day Conference in conjunction with the French and German Institutes.
Sept.	2-8.	S.B.A.C. Show, Farnborough.

One of South African Airways' three DC-7Bs, ZS-DKE "Reiger," seen over Johannesburg. The airline's DC-7Bs, which are named after early ships to reach the Cape, are now operating into Amsterdam. A fourth 7B is to be delivered to S.A.A. next year.

CIVIL AVIATION

MORE ORDERS FROM T.C.A.

OPTIONS on 13 Vickers Viscounts and two Douglas DC-8s were taken up last week by Trans-Canada Air Lines. This decision brings the total number of Viscounts ordered by the airline to 51 and that of DC-8s to six.

At present 25 Viscounts are in T.C.A. service and four more are to be delivered in May. Deliveries will be continued in December of this year until completion of the order by June 1958. The DC-8 deliveries are expected to begin late in 1959 and these machines will operate on the long-range transatlantic and trans-continental routes in 1960.

The current total of Viscounts sold to the dollar market is now 147. In addition to the T.C.A. aircraft 75 are for Capital Airlines and 15 for Continental Air Lines, while six are executive versions. This recent T.C.A. order is valued at some $17m (£6m).

V.O.R. BEACONS IN BRITAIN

DETAILS of the extended programme for the installation of V.H.F. omni-range navigation beacons in the United Kingdom are given in M.T.C.A. *Information Circular No. 40/1957* (*Tels. 13/57*). The new notice takes account of revised and planned airways alignments, and indicates that V.O.R. sites will be established at 15 locations. The first six of these to come into operation will be at Clacton, Strumble, Chertsey, Prestwick, Bristol and Dungeness, all of which should be established during the second half of this year. The existing V.O.R. installation at Llanwinio is to be retained until operational service is available from Strumble.

Between December 1958 to May 1959 further installations are scheduled to come into operation, at Dover, Halifax, Daventry, Wallasey, Kintyre and the Isle of Man, followed in the period May to December 1959, by others at Seaford, Hurn (Ibsley), and Renfrew.

THE BLACKBUSHE VIKING ACCIDENT

QUESTIONS in Parliament concerning the present system of air trooping followed the accident to Viking G-AJBO of Eagle Aviation at Blackbushe on the night of May 1, in which 33 people were killed. The aircraft, carrying 30 passengers and a crew of five, crashed while making an emergency return to the airfield shortly after taking off for Lyons and Idris, Libya, on a flight under charter to the War Office. This was Eagle's first accident involving injury to passengers.

In the House of Commons on May 2 the Under-Secretary for Air, Mr. Orr Ewing, announced that a public inquiry would be held. Mr. Geoffrey de Freitas asked for a re-examination of "the serious charges which have been made in the House in the last year or two against the present system of air trooping," and Mr. Herbert Morrison criticized the Governments "bias against the use of public corporation aircraft." The Prime Minister repeated that there would be a full public inquiry into this particular accident and said that the wider issues would be looked into.

U.S. AIR SAFETY PLAN

RECENTLY recommended by the Engineering Group of President Eisenhower's Aviation Facilities Planning Commission is a new plan for air traffic control in the U.S.A. It includes proposals for the immediate future, gradual modernization and improvements by 1960, and an entirely new system by 1967.

Immediate proposals are that (1) the present A.T.C. expansion programme, involving more radar equipment and more personnel, should be accelerated; (2) a group should be formed within the Civil Aeronautics Administration to analyse current air traffic bottlenecks; (3) all traffic above 18,000ft should be placed under the direction of A.T.C. centres; and (4) certain high-density routes should be expanded by establishing one-way airways, separated according to aircraft speeds.

According to the new plan, 85 per cent of all commercial, military and private traffic would eventually be brought into controlled airspace—compared with the average of 12 per cent of present traffic which is under Federal air traffic control. By 1965, it is suggested, all traffic above 10,000ft would be operating in controlled airspace.

A large-scale research programme is recommended. Costing up to $40m per year, it would involve the development of new electronic, navigation and communications devices and the modernization of airport runways to permit the speedier handling of traffic.

The Group emphasizes that A.T.C. research should be under the control of one authority such as the proposed Airways Modernization Board. The eventual establishment of a central group to determine national aviation policy is recommended.

BRAZILIAN FRIENDSHIP PRODUCTION

LAST year we referred to a Fokker statement that licence agreements to build the Friendship had been negotiated with Bréguet in Europe and Fokker's associate company Industria Aeronautica of Rio de Janeiro. It is now reported that the Brazilian Government has been participating in a further agreement between the Brazilian Fokker company and its parent for the construction of a batch of 100 Friendships, part of which, it is said, will be purchased by the government to replace older piston-engined aircraft used to fly cargo and mail on government services in the interior. Other Friendships built by the Brazilian Fokker concern, will, it is further understood, be sold to Brazilian commercial operators.

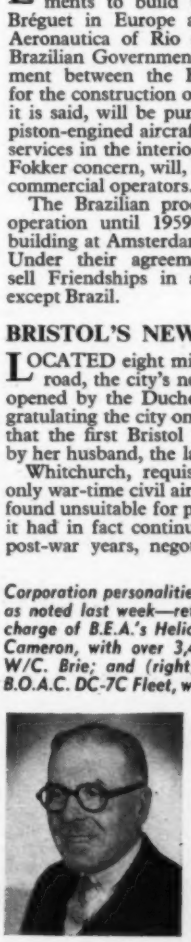
The Brazilian production line will probably not be in full operation until 1959. In the meantime Friendships will be building at Amsterdam and at the Fairchild plant at Hagerstown. Under their agreement with Fokker, Fairchild are able to sell Friendships in all North and South American countries except Brazil.

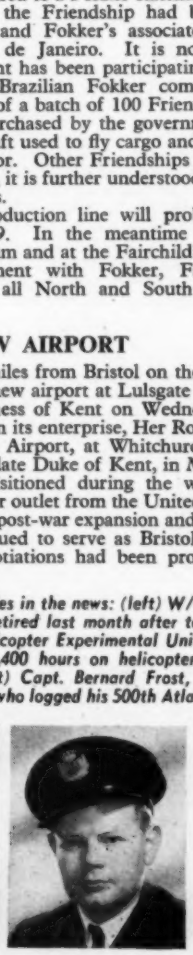
BRISTOL'S NEW AIRPORT

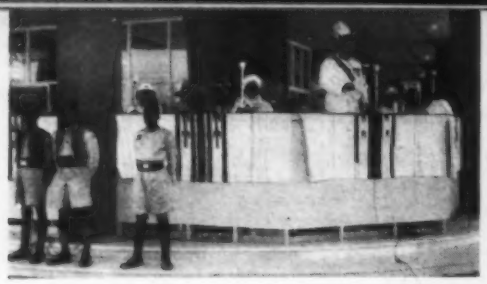
LOCATED eight miles from Bristol on the main Bristol-Exeter road, the city's new airport at Lulsgate Bottom was formally opened by the Duchess of Kent on Wednesday, May 1. Congratulating the city on its enterprise, Her Royal Highness recalled that the first Bristol Airport, at Whitchurch, had been opened by her husband, the late Duke of Kent, in May 1930.

Whitchurch, requisitioned during the war and forming the only war-time civil air outlet from the United Kingdom, had been found unsuitable for post-war expansion and development. While it had in fact continued to serve as Bristol's airport during the post-war years, negotiations had been proceeding for the sale

Corporation personalities in the news: (left) W/C. R. A. C. Brie, who—as noted last week—retired last month after ten years as official-in-charge of B.E.A.'s Helicopter Experimental Unit; (centre) Capt. J. A. Cameron, with over 3,400 hours on helicopters, who has succeeded W/C. Brie; and (right) Capt. Bernard Frost, flight captain of the B.O.A.C. DC-7C Fleet, who logged his 500th Atlantic crossing on May 2.







(Left) The Governor of Nigeria, Sir James Robertson, opening Kano Airport's new terminal last Saturday (see Col. 2). The Emir is on his right. The other picture shows the Valiant B.1 and Comet C.2 sent by the R.A.F. to attend the ceremony. "Flight" photographs

CIVIL AVIATION . . .

to the City Council of the ex-R.A.F. field at Lulsgate. This was finally arranged at a purchase price of £55,000.

The facilities at Lulsgate include a new terminal building on the north-east side and an operations and administration area located near the control tower. The instrument runway (097-277) is 1,300 yd long and the subsidiary runway (157-337) is 1,100 yd. High-intensity approach lights and low-intensity runway lights are being installed and a gradual expansion of navigational and other facilities is planned.

The layout of the terminal building has been dictated primarily by passenger-handling requirements, and includes a restaurant and bar on the first floor; ultimate extensions are envisaged. Also on the first floor are the lounge and bar of the Bristol and Wessex Aeroplane Club, which since its inception has been associated with the Bristol municipal airport.

Speaking at the opening ceremony, Mr. Harold Watkinson, Minister of Transport and Civil Aviation, commented that Lulsgate had excellent approaches in all directions and was very well placed. Ingenuity had been shown in the planning of the new terminal building, which was an example of good design well fitted to its purpose.

Following the opening ceremony a demonstration flight was made by Britannia G-ANBN; other aircraft present included those of the airport's regular users, Aer Lingus, Cambrian Airways and the Bristol and Wessex Aeroplane Club.

COMMENT ON CUNARD CRITICISMS

CRITICISM of the Airways Corporations' economic policy by the chairman of the Cunard Steam-Ship Company was answered by Mr. Gerard d'Erlanger, chairman of B.O.A.C., in London last week. The critical comments had been contained in the Cunard company's annual statement to shareholders by the chairman, Col. D. H. Bates.

The Cunard statement had said that the Corporations appeared "able to ignore such normal factors of transportation as cost and profit margins." Other points were that profit and loss did not seem to have been given much consideration, losses of £40 million had been incurred, and it appeared that the airlines were able to regard pounds as "meaningless symbols." While the numbers of air passengers had increased enormously, those travelling by sea had also increased, but this could not be expected to continue if air travel continued to become cheaper and sea travel dearer.

Mr. d'Erlanger, replying to the "pretty misleading statements" of Col. Bates, said that cost and profit margins were at all times in the forefront of the minds of the Board and management of B.O.A.C. "While providing the best possible service at least cost," he added, "it has been, and is, our cardinal object to make adequate profits and avoid losses." While it was true that, in the immediate post-war years, B.O.A.C. received £31m in subsidy "to rehabilitate an industry which had been virtually wiped out by the war," the Corporation had made a profit in each of the past six successive years without Exchequer grant.

Airline profit margins were at present insufficient, said Mr. d'Erlanger. The Corporation's aim was to seek greater surpluses in order to provide reserves for the replacement of equipment, not by wholesale fare-increases which would narrow the market and turnover, but by keeping fares down and so broadening the market and increasing turnover.

DARTS FOR THE HERALD

FOR some months now it has been known that Handley Page have been gauging airline-reaction to a possible turbine-powered version of the Herald. Now the company announces that a Herald is being fitted with two Rolls-Royce Darts "to exploit to the fullest the private venture Herald's suitability for operation . . . in both developed and undeveloped areas."

No performance figures for the Dart Herald are available as we go to press, but it is clear that the installation of these engines is certain to widen the appeal of the aircraft in a local-service branch-liner market which is becoming increasingly turbine-minded.

Handley Page say that parallel production is planned of both the Dart-engined Herald and the present version with Alvis Leonides Major piston engines. We hope to give more details of the Dart Herald in next week's issue.

KANO'S NEW TERMINAL

WHEN Nigeria's Minister of Aviation, Dr. K. O. Mbadiwe, spoke at the opening of Kano Airport new terminal last Saturday, he said: "This airport will bear comparison with any you may meet anywhere in your travels." Dr. Mbadiwe (writes a member of *Flight's* staff who flew by Comet 2 to Africa for the ceremony) was not exaggerating—Kano, geographical staging point for the long desert crossing to and from Europe, now possesses an airport of which any city anywhere would be proud. Traffic, 90 per cent of which comprises passengers in transit, is mounting steadily, and S.A.A. recently joined the seven international airlines which use Kano—Air France, B.O.A.C., C.A.A., K.L.M., PanAm, Sabena, and T.A.P.

The fine new terminal building (photograph above), which took three years to construct at a cost of £500,000, was opened by H.E. Sir James Robertson, Governor-General of the Federation of Nigeria, amid scenes which for sheer colour and spectacle rivalled those witnessed during the visit of Queen Elizabeth II. (The Emir of Kano, head of the local Moslem tribes and a leading figure in the ceremony, was attended by 700 horsemen, many of whom came from hundreds of miles around.)

As well as being sensibly laid out, the new terminal is a beautiful example of modern architecture. We hope to devote more space to it next week.

For the record, the first aircraft to be greeted at the new terminal by Kano's famous camel-mounted trumpeter ("Herald of the Aerial Caravans") was a West African Airways Argonaut from Lagos. It touched down at 1730 hr G.M.T.—honours for the first arrival having nearly gone to a W.A.A.C. Heron, diverted earlier owing to the sudden intervention of a tropical storm.

BRAZIL ORDERS VISCOUNTS

THE Brazilian airline VASP of Sao Paulo, which operates DC-3s and Scandias, has ordered five Viscount 810s for delivery in the mid-summer of 1958.

This order, together with T.C.A.'s repeat order for 13 (reported on the previous page), brings the total number of Viscounts sold to within 15 of 400.

AIR CHARTER - SABENA LINK

JOINT operations by Air Charter and Sabena, due to begin on June 4 on the "Channel Air Bridge" Southend-Ostend car ferry service, were announced in London last week. The pooling of services on this route, which will continue to be flown with Bristol 170 Mk 32 aircraft, is based on a planned total of 24 services daily this year and up to 50 daily in 1958.

At present Air Charter's Channel Air Bridge system connects Southend with Calais, Ostend and Rotterdam. A total of 15,000 vehicles and 40,000 passengers were carried on these routes during 1956, of which 1,500 vehicles and 7,000 passengers were flown on the Ostend service. A marked increase of traffic, in particular of that emanating from the continent, is foreseen in the new agreement between the two companies.

A number of Air Charter's Superfreighters will be chartered to Sabena and, in Sabena colours, will be flown by Belgian aircrew. A joint vehicle-reservation office will be operated by Air Charter's Channel Air Bridge division at the company's new Wigmore Street offices.

BREVITIES

RECENTLY formed with the assistance of S.A.S., two newspaper publishers and A. B. Airtaco, a new Swedish air transport company known as A. B. Linjeflyg is to take over from S.A.S. most of Sweden's domestic routes.

* * *

B.O.A.C. have appointed Mr. Alan N. Greaves as regional advertising manager for the Americas, with headquarters in New York.

* * *

Pan American will be ready for "prompt inauguration" of Boeing 707 services, states Mr. Juan Trippe, the airline's president, when deliveries of the aircraft begin in December 1958.

Vickers Viscounts went into service with the Italian airline L.A.I. for the first time on May 1, on the Rome-Cagliari and Rome-Milan-Zurich services.

* * *

Mr. H. Keeling, an M.T.C.A. operations officer, has been awarded £250 under the departmental suggestions scheme for devising a new method of checking G.C.A. aids at airports. This method is expected to save at least £5,000 per year.

* * *

Mr. W. A. Edmenson, C.B.E., D.L., and Mr. S. Kenneth Davies, C.B.E., have been re-appointed to the board of British European Airways for periods of two years and three years respectively.

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The Civil Aeronautics Board has recommended that Pan American's application to operate non-stop passenger flights between New York and Washington, D.C., and Mexico City be granted. A competing application by Eastern Air Lines was rejected.

* * *

Reports from Prague state that long-term plans for civil aviation in Czechoslovakia include the introduction of experimental passenger helicopter services between major cities during 1958 and 1959, followed by regular flights in 1960.

Peking Airport, "the most modern in Asia," will be ready for operation by the end of this year, Peking radio reports.

* * *

The first B.O.A.C. Constellation 749A to be sold under the Corporation's re-equipment programme was recently handed over to Pacific Northern Airlines of Seattle. This aircraft, G-ANUX, was one of seven acquired from Capital Airlines in 1954.

* * *

Mr. Adrian Head has been appointed Swissair sales representative for the City of London. Mr. Roy Maurer is now secretary to the management of Swissair for the U.K. and Ireland.

* * *

Mr. Robert L. Jahnke has been appointed manager of commercial sales for the European area by the Allison Division of General Motors of America. His principal base will be Frankfurt and he will devote a major proportion of his time to liaison with airlines concerning the progress of the Allison 501 turboprop.

* * *

A report in the *Financial Times*, on which B.O.A.C. do not comment, states that the Corporation has proposed to Central African Airways a scheme to take over the overseas services of the airline, which have been making a loss.

CLUB AND GLIDING NEWS

SHOWN at the Kronfeld Club, London, on Wednesday, May 1, was the excellent French film of last year's World Gliding Championships at St. Yan. Brought over from France on this occasion by Monsieur Gerbier, chief meteorologist at the championships, the film includes some magnificent air-to-air colour photography and a selection of ground sequences which portray extremely well the background atmosphere of championship gliding. Notable are the in-flight views of a number of pilots, including MacReady and Wills, who, flying a Bréguet 904 in turn from the rear seat, were photographed by a rearward-facing camera mounted in the front cockpit. At the Kronfeld Club showing—the first and only in this country so far—the sound track was distorted and for the most part unintelligible. Visually the film is superb; we hope that it will soon be possible to give the film the much wider audience which it deserves in this country.

LUTON Flying Club are organizing an At Home and flying display on Sunday, May 26, to which all neighbouring clubs are invited. A total of 1,900 hours was flown by the club's Tiger Moth and three Austers during the year ending March 31, and 20 P.P.L.s were obtained. A ground-instruction school was well attended during the winter and will restart in the autumn.

Last month's spot-landing competition was won by Mr. B. Preston, flying an Auster, with Mr. W. Shirley second and Mr. T. Stamper third. Current flying rates at Luton are £3 7s 6d (Tiger Moth and Cirrus Austers) and £3 12s 6d (Gipsy Auster).

ARMSTRONG SIDDELEY Flying Club are celebrating their final payment to the Kemsley Flying Trust on Tipsy G-AFSC with a dinner and dance at Baginton tomorrow, May 11. The club was founded almost five years ago, and the Tipsy was purchased from the Cardiff Flying Club with founder-members' subscriptions and a K.F.T. loan. Present membership of the A.S. club is 40, of whom seven hold P.P.L.s and 28 have achieved solo stage.

OVER 70 people attended a party given at Detling by the Kent Gliding Club on April 27, to celebrate the club's first anniversary. The evening's entertainment was shared by a welcome number of visitors from most of the southern gliding clubs.

The club membership, which last year started at 40, has now reached 100 flying members and 50 associates. In the club's first year 34 members have flown solo, a number have since gained "C" certificates, and some of the more experienced pilots have flown on cross-country and duration flights. The total flights in the year amounted to nearly 5,000. Another winch is now being constructed and it is hoped to exceed this figure next year.

Steve Green (left) and Hugh Jones of the Kent Gliding Club, seen with "Harry," who provides ballast on solo T-21b flights from Detling.

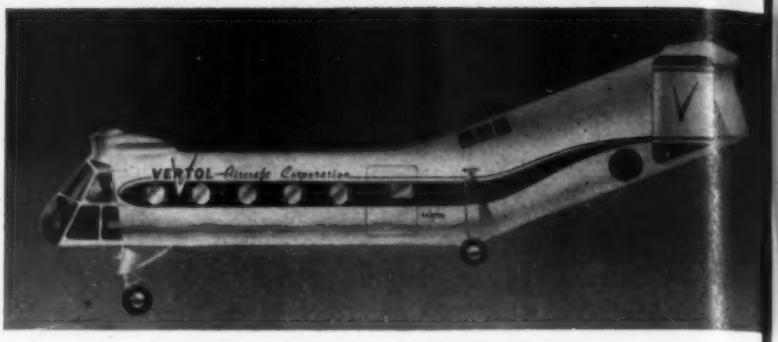
LONDON Gliding Club flew 2,182 hours from 7,895 launches during 1956, and cross-country mileage totalled 1,800 miles. This was reported on April 27 at the annual general meeting by Mr. Godfrey Lee, chairman of the club, who stated that there were just under 400 members, of whom 305 were flying members.

The year's activities, Mr. Lee continued, had included the purchase of a Skylark 2, the fitting of the Olympia with a wheel and the Tutors with spoilers and the start of operations with the third T-21b, which was fitted with blind-flying instruments. With the loan of Mr. John Furlong's Tiger Moth, two such aircraft were now available for aero-tows. During the first four months of 1957, over 1,400 cross-country miles had been flown in 25 flights. The chairman considered that 1956 had been a very successful year, largely due to the efforts of the club staff—Mr. Ray Stafford Allen, manager; Mr. John Everitt, C.F.I.; and Mr. Noel Quinn, ground engineer.

What large-scale production of light aircraft really means is indicated by these two recent photographs from Lock Haven, Pennsylvania. Left, the 1,000th Piper Apache is delivered to Dr. and Mrs. T. J. Gamble by Mr. J. W. Miller of Piper; while on the right Mr. W. T. Piper (right) company president, is seen with the purchaser of the 5,000th Tri-Pacer, Mr. J. M. Brittingham (left) and Piper agent, J. Robinson.

VERTOL 44

Civil Version of the H-21



CIVIL certification of the Vertol H-21 helicopter is now complete and two of these machines, called Vertol 44s, are to provide a shuttle service between the centre of Paris and Le Bourget during the coming Paris Air Show. They will each have a luxurious 14-seat passenger cabin-layout. The comparison between this machine and the Sikorsky S-58, which is already in civil service in Europe and America, is the more interesting as both machines have virtually the same engine, namely, a 1,425 h.p. Wright Cyclone similar to the military R-1820-103. The S-58 has the cost and maintenance of a single rotor system, while the Vertol 44 offers wider c.g. limits and, the makers claim, better directional control, from its twin rotor system. At a gross weight of 14,000 lb, the 44 has a cruising speed of 88 kt, a sea-level rate of climb of 1,050ft/min and a hovering ceiling, in ground effect, of 5,000ft.

There are, in fact, three versions of the Vertol 44. The 44A is a civil/military cargo and ambulance machine having 19 or 20 troop seats, or 600 cu ft of clear cargo stowage space, together with two access-doors and strengthened floor, or accommodation for 12 stretchers in four tiers of three, with two seated attendants. A cargo hoist with a capacity of 600 lb is an optional extra which can be fitted at the forward starboard access door. There is also an external cargo sling with a capacity of 5,000 lb.

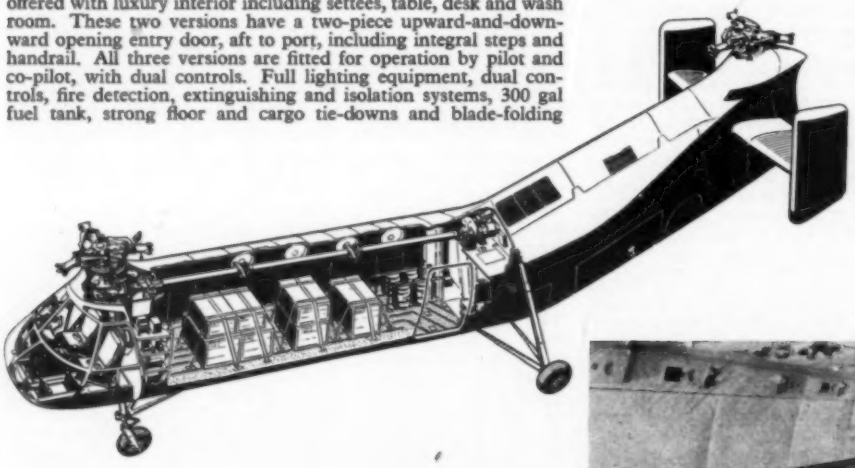
The 44B is the commercial passenger transport version with 15 seats, most of them in pairs down the starboard wall. A trough for hand luggage extends down the port wall and further luggage can be stowed in a compartment aft of the main cabin. All seats can be folded or unshipped for partial or full cargo conversions. As an alternative, the 44C executive transport is offered with luxury interior including settees, table, desk and wash room. These two versions have a two-piece upward-and-downward opening entry door, aft to port, including integral steps and handrail. All three versions are fitted for operation by pilot and co-pilot, with dual controls. Full lighting equipment, dual controls, fire detection, extinguishing and isolation systems, 300 gal fuel tank, strong floor and cargo tie-downs and blade-folding standard three-ton lorry back up to the doors without danger. Optional items not included in the basic weight figure include communications and navigational radio, landing and collision-warning lights, power hoist and cargo sling, gyro-magnetic compass, 250-gal self-sealing drop tanks, internal self-sealing tanks, flotation gear, flare installation and armour plating.

The demonstration in service of Vertol 44s at Paris at the end of this month will mark a strong sales drive for these helicopters in Europe, both for civil and further military applications.

Vertol 44 (Wright Cyclone 977C9HD1 giving 1,425 h.p. at take-off and 900 h.p. at maximum cruising setting).—Length over fuselage, 52ft 6in; length over rotor discs, 86ft 4in; height, 15ft 5in; width over fins, 13ft; rotor disc diameter, 44ft; empty weight, with standard equipment, 8,655 lb; useful load, 5,345 lb (military, 6,345 lb); gross weight, 14,000 lb (military, 15,000 lb).

Performance at 14,000 lb: sea-level maximum speed, 110 kt; cruising speed, 88 kt; maximum sea-level rate of climb, 1,050 ft/min; hovering ceiling in ground effect, 5,000ft; hovering ceiling out of ground effect, 3,500ft; cruising fuel consumption, 75 U.S. gal/hr; range, with reserves, on standard 300 U.S. gal tankage, 315 n.m.; seating capacity, in addition to two pilots, 15 to 19 or 12 stretcher cases; fuel used, 100/130 octane.

Cabin dimensions: length, 20ft; height to transmission trunk, 5ft 6in; floor width, 4ft; maximum width, 5ft 8in.



The general layout of the Vertol 44 in its civil and military cargo version (left) shows the transmission runs and freight cabin. The single 1,425 h.p. Wright Cyclone is aft of the cabin. Below, the 15-passenger layout, here seen looking aft, shows passengers to starboard and luggage rack to port. Ventilators and reading lights are next to each seat.

provision are included in the standard empty weight of 8,655 lb. Civil and military useful loads are respectively 5,345 lb and 6,345 lb.

A U.S. Army H-21 gained the world's helicopter closed circuit distance record with a non-stop flight of 1,199 miles; and military machines serving in several countries have shown good performance and versatility. They have operated in the Arctic and the tropics, and at heights up to 14,000ft. One H-21 towed a 3,000-ton tank-landing ship at 5 kt and pulled a tracked amphibious vehicle over land. Easy accessibility and integral servicing platforms and steps, together with interchangeability of many of the fore and aft rotor parts, have been retained in the civil versions. Vertol factories in the U.S.A. and Canada and licensees in Europe and the Far East offer overhaul and spares service for civil and military users.

Useful operating features of both the H-21 and Model 44 are the forward and after access doors, 20ft-long cabin, and a permissible c.g. travel of 41in. The rotors are sufficiently high off the ground to provide ample clearance for people and to let a

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Timetable to Tokyo

WHEN the Duke of Edinburgh visited the R.A.F. Flying College at Manby on May 2 he was given details of Exercise Big Top—the projected flight by the Canberra P.R.7 *Aries V* from London Airport to Tokyo and return in a total elapsed time already worked out at 38 hr 20 min.

This flight will be made over the Arctic regions and its purpose is to investigate navigational aids and meteorological conditions over the Northern route. The Canberra is due to leave London Airport at 0810 hr on May 23 and to arrive at Tokyo at 0205 on May 24. Stops will be made at Keflavik (Iceland) and Fairbanks (Alaska).

The last stage will be a distance of 3,617 miles and the total elapsed time for the outward flight is fixed at 18 hr 55 min for the 7,936 miles with flying time of 17 hr 5 min, at an average speed of 464 m.p.h. Long stages will be flown at between 40,000ft and 50,000ft and shorter ones at slightly under 40,000ft.

The aircraft will be at Tokyo for 2 hr 40 min before starting its return flight. It is to call at Fairbanks—now a distance of 3,800 miles—for one hour and then fly straight to R.A.F. West Malling, arriving there at 2230 on May 24. Its elapsed time for the return flight of 8,011 miles will be 16 hr 45 min, giving a flying time of 15 hr 45 min at an average speed of 510 m.p.h. The Canberra is expected to set up a record for the flight, which will take 32 hr 50 min at an average speed of 510 m.p.h.

On the outward flight the crew will be W/C. R. F. Harman (captain), S/L. B. Hamilton (navigator), F/L. H. Hopkinson (second pilot); and on the return flight W/C. W. Hoy, F/L. J. L. Denis and F/L. P. J. Lagesen.

Comet's American Visit

NEXT Friday a Comet 2 of R.A.F. Transport Command is due to leave Lyneham for North America, carrying specialist navigation personnel from the R.A.F. Flying College at Manby on a 17-day tour of R.C.A.F. and U.S.A.F. units. The aircraft has been selected for this purpose by Flying Training Command and it will be the first visit to America by a Comet of the R.A.F.

Sponsored by A.V-M. Harvey, A.C.A.S. (Training), the flight is designed for economy as well as prestige reasons; for it will not only give an opportunity of demonstrating the R.A.F. Comet before high-ranking officers and experts in Canada and the U.S.A., but it will also save dollars. Previous annual visits to America by R.A.F. navigation specialists have been undertaken in several aircraft. Both time and money will be saved by the whole party travelling in the Comet.

The flight will involve a 12,000-mile outward journey *via* Goose Bay (Labrador) and Keflavik (Iceland). One of the passengers will be Air Marshal Sir Richard Atcherley, A.O.C-in-C. Flying Training Command, who is going to Washington on a liaison mission to the U.S.A.F. and the Pentagon.

Visits are being paid to—among other establishments—the R.C.A.F. Central Navigation School at Winnipeg and the U.S.A.F. Air Development Center at Wright Patterson. The return flight is due to be made *via* Bermuda and the Azores, arriving at Lyneham on June 3.

C.A.S. Criticizes "Speculation"

IN his speech at the Royal Academy Banquet on May 1 the C.A.S., Air Chief Marshal Sir Dermot Boyle, said he welcomed public discussion of the changes brought about by the Defence White Paper but regretted that there had been "a spate of wild and uninformed speculation by those who prefer to think in terms of revolution rather than evolution."

Adding that there had been "prophecies which bear no relation whatever to the facts and which cannot but have a profoundly discouraging effect on those now serving and on the future recruiting prospects of the Services," the C.A.S. continued: "I cannot believe that those who are responsible for these speculations are aware of the damage which they are doing to the Armed Forces and therefore to the country, and indeed to the new defence plans which themselves depend for success on obtaining sufficient regular recruits."

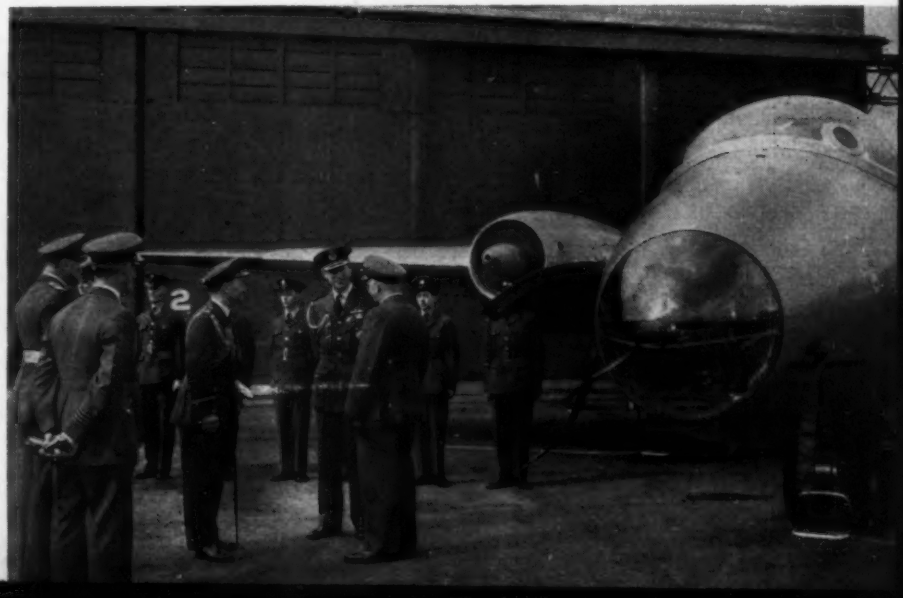
Air Chief Marshal Sir Harry Broadhurst, A.O.C-in-C. Bomber Command, presenting the Standard to No. 111 Squadron—which he commanded early in the last war, scoring its first victory—at North Weald on April 30.

Birmingham U.A.S. Dinner

GENEROUS praise for the University of Birmingham, and a warm tribute to the R.A.F., were the order of the evening when the University Air Squadron held its annual dinner at Edgbaston on April 30. In a thoughtful speech A.V-M. H. V. Satterly, A.O.C. of No. 64 Group, said he considered the University to be one of outstanding importance in this country's scientific and industrial life; he had nothing but praise for the people who established it; and with the R.A.F.'s growing demand for scientists and technicians he believed it would play an increasing part in the defence of this country.

Continuing the theme in his reply, the Vice-Principal, Professor A. P. Thomson, said that the University owed a great debt to the R.A.F. and he wished he knew the magic by which it had been able to acquire so great a tradition in such a short time and the spirit (as he put it) "of finding something greater than yourselves to serve." Foreign visitors to Birmingham, he added, thought that it was there the course of life on this planet had been changed—by the application of power to industry. And he recalled Boulton's famous remark to Boswell: "Sir, I have here what all men desire —power."

There was a meed of praise, too, for the squadron from A.V-M. A. D. Gillmore, S.A.S.O., Home Command, who said reports showed it to be "as flourishing as ever"—although last year's Hack Trophy success had not been repeated and there had been a slight falling-off in strength of the Airfield Construction Flight. The majority of members were in their first or second year at the University; five former members had gained R.A.F. commissions since last August, four of them as pilots;



H.R.H. the Duke of Edinburgh with officers of the R.A.F. Flying College during his visit to Manby. On the right is the Canberra "Aries V" which is due to make the return flight to Tokyo described above.

F/L. A. E. M. Barton, first officer on a U.S.A.F. exchange posting to win the Strategic Air Command's "Heads Up" trophy, receives it from Brig-Gen. D. Wade, S.A.C. Chief of Staff. F/L. Barton won it for landing his Boeing KC-97 at Thule A.F.B. after a fuel line had broken. All his crew except the co-pilot baled out and F/L. Barton avoided using any electrical equipment likely to cause fire.

SERVICE AVIATION

and there had been no squadron flying accidents since March 21 last year. As for the future, despite "gloomy prognostications", there need be no apprehensions: "You would only be deluding yourselves if you thought that because the Auxiliaries had been disbanded the university air squadrons would be so too. We know the value to the R.A.F. of officers who have had a university training."

The squadron's commanding officer, S/L. B. E. Hogan, paid tribute to the support and encouragement of the University staff. He recalled regretfully that the Hack Trophy had been presented at last year's dinner and hoped that the squadron, having been second in flying this year, would pull up in ground subjects next time. He announced the award of the Priestley Trophy—for the best all-round cadet—to Cdt. Plt. Ian Conradi, and this was presented by the Vice-Principal.

Finally Sir Robert Marriott, replying to the toast of the guests (proposed wittily, not to say formidably, by P/O. G. F. Round), echoed the thoughts of all other visitors when he wished the B.U.A.S. "a very long flying life."

Senior Appointments

THREE senior appointments were recently announced by the Air Ministry. A.V-M. W. G. Cheshire is to be R.A.F. Instructor at the Imperial Defence College; A.V-M. A. Earle is to be A.O.C. No. 13 Group, Fighter Command (both appointments taking effect in July); and A. Cdre. W. H. Hutton becomes Director of Manning at Air Ministry, from the beginning of this month.

A.V-M. Cheshire has been A.O.C. No. 13 Group, Fighter Command, since June 1955 and before that was A.O.A. at 2nd T.A.F. for two years. A.V-M. Earle has been A.C.A.S. (Policy) since March 1955 and was previously Director of Policy (Air Staff). A. Cdre. Hutton has been A.O.A. at H.Q., Coastal Command, since July 1954.

No. 41 Sqn. Standard

ON Sunday, July 14, a Standard is to be presented to No. 41 Sqn. by Air Marshal T. N. McEvoy at R.A.F. Biggin Hill. The ceremony will take place at 1100 hr, and the squadron invites all former members. Those wishing to attend should contact the Adjutant, No. 41 Squadron, R.A.F. Biggin Hill, Kent.

Sandison Trophy Presented

LAST Saturday the first presentation of the Robert Sandison Trophy—given to the F.A.A. by Mr. Paul Sandison in memory of his son Lt. R. Sandison, late of No. 831 Sqn.—took place in H.M.S. *Ark Royal* at Spithead. Mr. Sandison had stipulated that the trophy, which is to be awarded annually to the most efficient strike bomber pilot in the F.A.A. and takes the form of a solid silver model of a Wyvern, should on the first occasion go to a pilot of No. 831 Sqn. Lt. J. T. Spafford of this squadron, which is embarked in *Ark Royal*, received the trophy from Mrs. Sandison at a ceremony in the ship's upper hangar.

No. 13 Sqn. Honoured

ON May 3 Field Marshal Sir John Harding, Governor of Cyprus, presented a Standard to No. 13 Squadron at R.A.F. Akrotiri. At present equipped with Canberras, No. 13 is a P.R. squadron and is commanded by S/L. J. L. Field. It was formed in 1915.

Norwegian Award

AT a ceremony in the Norwegian Ambassador's residence in London on May 3 the Norwegian Medal for Heroism was presented to F/O. V. Kyrke-Smith of No. 284 Squadron, based at Nicosia.

F/O. Kyrke-Smith, who is now Sir John Harding's personal pilot, received the award for his part in the rescue by helicopters of crew members from the Norwegian tanker *Dofvrejell* when she went aground in the Pentland Firth in February last year.

R.C.A.F. Rescue Award

FOR his part in the rescue of eight people from the flooded River Alouette in British Columbia during November 1955, F/Sgt. W. Hetman of R.C.A.F. station Vancouver has been awarded a Queen's Commendation for Brave Conduct.

In their recent announcement of this award, R.C.A.F. headquarters state that F/Sgt. Hetman, a motor-boat crewman, was called upon to assist in the evacuation of eight civilians marooned on a pile of bush and rubbish in the flooded river. With three civilian volunteers, he attempted to reach them in a 25ft open boat, but the swift current made this impossible.

F/Sgt. Hetman tied a line round his waist, plunged into the icy water and waded chest-deep towards the stranded people. He remained in the water for about five hours, eventually bringing everyone to safety. His citation speaks of "the courage and unselfishness displayed by F/Sgt. Hetman, and the complete disregard for his own personal safety, in this hazardous rescue operation."

W.R.A.F. Recruiting

AN attractive booklet—*In A Winged World*—has been prepared for the Air Ministry by the Central Office of Information to encourage W.R.A.F. officer recruitment. Written by Marjorie Beckett and illustrated with photographs and drawings, it describes commissioned service in the W.R.A.F. and forms one of the means to improve recruiting urged as necessary by the Secretary of State for Air in his Memorandum on the Air Estimates.

IN BRIEF

Edinburgh University Air Squadron won the annual Scone Trophy competition at Scone Aerodrome, Perth, on May 1. Glasgow U.A.S., the holders, were second.

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R.A.F. Innsworth became "triple crown" holders on April 24 when, having already within twelve months won the inter-unit cricket and soccer championships, they beat West Kirby at rugby by 26 pts to 6 pts.

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A memorial is to be erected at R.A.F. Leuchars, Fife, to the Norwegian squadrons which flew with R.A.F. Coastal Command during the war and to Norwegian aircrews who helped to operate the air transport service between Scotland and Sweden.

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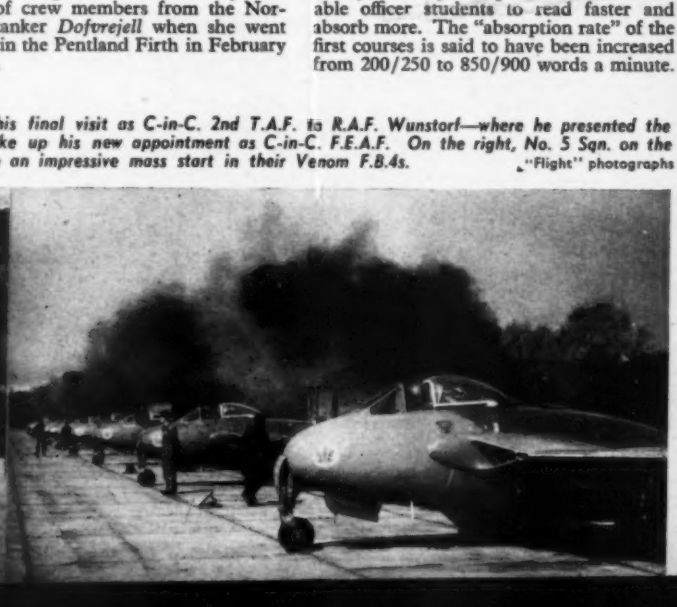
The R.A.A.F. Staff College at Point Cook, Victoria, has opened a clinic to enable officer students to read faster and absorb more. The "absorption rate" of the first courses is said to have been increased from 200/250 to 850/900 words a minute.

(Below, left) Air Marshal the Earl of Bandon during his final visit as C-in-C. 2nd T.A.F. to R.A.F. Wunstorf—where he presented the Sassoon Trophy to No. 541 Sqn.—before leaving to take up his new appointment as C-in-C. F.E.A.F. On the right, No. 5 Sqn. on the Wunstorf tarmac make an impressive mass start in their Venom F.B.4s. "Flight" photographs



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